

THE
CABINET-MAKER
AND
UPHOLSTERER'S
DRAWING-BOOK.
IN THREE PARTS.

THOMAS SHERATON,
CABINET-MAKER.

LONDON:
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CONTENTS OF THE THREE PARTS.

PART I.

Containing such Geometrical Lines and Instructions as are highly useful to Persons of both Branches, illustrated in Seven Copper-plates. To which are added the Five Orders, exhibited in five different Plates, proportioned by Modules, Minutes, and Aliquot Parts, according to the most approved Authority; together with some Account of their Antiquity and Origin.

PART II.

On Practical Perspective, applied to the Art of representing all Kinds of Furniture in different Situations; interspersed with something of the Theory, for such as would know the Principles on which this useful Art is founded. The Whole illustrated in Thirteen Copper-plates.

PART III.

A Display of the present Taste of Household Furniture; containing also useful Remarks on the manufacturing Part of difficult Pieces. To which are added, some Cornices drawn at large; the Method shewn of Gaging, Working, Contracting, and Enlarging of any Kind; together with two Methods of representing a Drawing-Room.

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A.

ALDAY John, Mahogany-merchant, Carlisle-street, Soho, London, 10 copies
 Angus, Cabinet-maker, Shug-lane, London
 Anderfon Henry, Cabinet-maker, ditto
 Anderfon Alexander, Cabinet-maker, ditto
 Archer William, Upholsterer, ditto
 Allan John, Cabinet-maker, ditto
 Atkinson Thomas, Cabinet-maker, ditto
 Arquart James, Profile-painter, ditto
 Allison Robert, Cabinet-maker, ditto
 Allen, Brewer, Burr-street, ditto
 Appleby, Cabinet-maker, Stockton
 Astle Thomas, Chester
 Alderton, Cabinet-maker, Brighton
 Angel Edward, Cabinet-maker
 Andrews, Cabinet-maker, Ipswich
 Adams, Cabinet-maker, Strand, London

Appleton C. Cabinet-maker, Hallifax
 Adams
 Atkinson William, Cabinet-maker, Rippon
 Ambler, Bookseller, Hallifax
 Alderson, Cabinet-maker, Newcastle
 Adams, Plasterer, Bristol
 Allen, Cabinet-maker, London
 Ackermann, Painter, Ruffel-street, London

B.

Bentham, Colonel
 Barclay, Esq. Edinburgh
 Bouch William, Cabinet-maker, Wells-street, London
 Beckwith, Cabinet-maker, Stockton
 Bream Samuel, Cabinet-maker, Yarmouth
 Burbury, Cabinet-maker, London

LIST OF SUBSCRIBERS.

- Blackstock P. Cabinet-maker, Cattle-street,
 Long-Acre, London
 Bensley Thomas, Printer, Bolt-court, Fleet-
 street, ditto
 Bagster J. Cabinet-maker, Piccadilly, ditto
 Bradley S. Cabinet-maker, ditto
 Bails J. Bedstead-maker, No. 434, Oxford-
 street, ditto
 Brown Michael, Cabinet-maker, London
 Beilock William, Cabinet-maker, ditto
 Brunton James, Cabinet-maker, ditto
 Brytam S. Cabinet-maker, ditto
 Balls Thomas, Cabinet-maker, ditto
 Binns Edward, Cabinet-maker, No. 1,
 Burden-street, Berkley-square, ditto
 Black John, Cabinet-maker, ditto
 Bowman William, Cabinet-maker, ditto
 Bales Simon, Cabinet-maker, Norwich
 Blades Thomas, Upholsterer, No. 114,
 Jermyn-street, London
 Bullock Richard, Cabinet-maker, ditto
 Bowman John, Cabinet-maker, ditto
 Beale John, Cabinet-maker, No. 7, Rose-
 street, Soho
 Beaumont Thomas, Carver, ditto
 Black Algernon, Cabinet-maker, ditto
 Batter, Upholsterer, Rochester
 Bonington and Thorpe, Clock-case makers,
 No. 22, Red Lion-street, Clerkenwell,
 London
 Black R. Cabinet-maker, ditto
 Bigger William, Upholsterer, ditto
 Bromridge, Cabinet-maker, George-yard,
 Hatton garden, ditto
 Borthwick, Bristol
 Borough, Cabinet-maker, London
 Bishop, Cabinet-maker, Houndditch, do.
 Baker, Cabinet-maker, Islington
 Barlow, Engraver, No. 5, George-street,
 London
 Blackland, Old Broad-street, ditto
 Burnie Charles, Cabinet-maker, ditto
 Bower, Cabinet-maker, No. 12, Round-
 court, Strand, ditto
 Blacklock, Cabinet-maker and Undertaker,
 No. 79, Park-street, ditto
 Brown James, Cabinet-maker, ditto
 Belfour Alexander, Cabinet-maker, ditto
 Browning John, Mahogany-merchant,
 No. 21, Southampton-street, Bloomsbury,
 London
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Wills, Cabinet-maker, Montrose

Williams, Chair-maker, Ipswich

Whitelock, Hallifax

Walling, Cabinet-maker, London

Wright James, Teacher of Mathematics

Williamson, Cabinet-maker and Upholsterer
Bedford-court, London

Wallace, Cabinet-maker, ditto

Weight, Cabinet-maker, Savoy-stairs, ditto

Watts, Cabinet-maker, ditto

White, Upholsterer, ditto

Williams John, Frodsham

Y.

Young, Trotter, and Hamilton, Cabinet
makers, Edinburgh

Yates John, Sheffield

Yates, ditto

Z.

Zeitler I. London

T O
CABINET-MAKERS AND UPHOLSTERERS
I N G E N E R A L.

GENTLEMEN,

I PRESUME, that to publish a Drawing-book answerable to the preceding title page will not require many words to convince you either of the necessity or propriety of the attempt.

Nor will it be requisite to use an ostentatious preface to recommend it to your notice, or to persuade you of the utility of such an undertaking. Therefore, what I have further to say in this Address shall be to give some account of my plan, and point out to you the difference between this and other books which have been published for the assistance and use of Cabinet-makers and Upholsterers.

Books

Books of various designs in cabinet work, ornamented according to the taste of the times in which they were published, have already appeared. But none of these, as far as I know, profess to give any instructions relative to the art of making perspective drawings, or to treat of such geometrical lines as ought to be known by persons of both professions, especially such of them as have a number of men under their directions. Nor have these books given accurate patterns at large for ornaments, to enrich and embellish the various pieces of work which frequently occur in the cabinet branch. Such patterns are also highly necessary to copy from by those who would sufficiently qualify themselves for giving a good sketch, or regular drawing, of any thing they meet with, or are required to draw for others. It is granted that there are books of ornaments already published sufficient for the above ends; but it may also be observed, that those ornamental books which are good, are very extensive, and of course very expensive: on the other hand, those that are cheap are either so small and ill drawn, or so deficient through brevity, or want of examples, as to render them of little use to the learner. Besides, were there no other reason for introducing ornaments into the following work, but the convenience of having a few good examples of this kind always at hand and ready to copy from, it would be sufficient to justify the attempt. Nor indeed would this performance answer so well to the title of a Drawing-book without them. I hope, therefore,

therefore, that it will be considered as an enhancement to the real value and usefulness of the Cabinet-maker and Upholsterer's Drawing-Book to compose and select some examples of such ornaments as shall serve, both for the purpose of the learner, and also to assist the ideas of those who have occasion to adorn their work in this way.

As I have alluded to some books of designs, it may be proper here just to say something of them. I have seen one which seems to have been published before Chippendale's. I infer this from the antique appearance of the furniture, for there is no date to it; but the title informs us that it was composed by a society of Cabinet-makers in London. It gives no instructions for drawing in any form, but we may venture to say, that those who drew the designs wanted a good share of teaching themselves.

Chippendale's book seems to be next in order to this, but the former is without comparison to it, either as to size or real merit. Chippendale's book has, it is true, given us the proportions of the Five Orders, and lines for two or three cases, which is all it pretends to relative to rules for drawing: and, as for the designs themselves, they are now wholly antiquated and laid aside, though possessed of great merit, according to the times in which they were executed. But it may here be re-
marked

marked to his credit, that although he has not given rules for drawing in * perspective himself, yet he was sensible of their importance and use in designing, and therefore he says in his preface: " Without some knowledge of the rules of perspective, the cabinet-maker cannot make the designs of his work intelligible, nor shew, in a little compass, the whole conduct and effect of the piece. These therefore, referring to architecture also, ought to be carefully studied by every one who would excel in this branch, since they are the very soul and basis of his art."

After Chippendale's work there appeared, in the year sixty-five, a book of designs for chairs only, though it is called " The Cabinet-maker's real Friend and Companion," as well as the Chair-maker's. This publication professes to shew the method of striking out all kinds of bevel work, by which, as the author says, the most ignorant person will be immediately acquainted with what many artists have served seven years to

* This is strictly true of the third edition of Chippendale's book ; but the first edition of it, printed in 1754, has given two chairs, a dressing table, and a book-case in perspective, shewing the lines for drawing them. But why these examples were not continued in the succeeding editions I know not. In the last edition of any work, we naturally expect to see it in its best state, having received its last revision from the author, or some other hand equal to the task ; and therefore it can never be thought unfair for a reader to form his judgment of a book from the last impression. I hope, therefore, this will sufficiently apologize for the above observation.

know.

know. But this assertion both exceeds the bounds of modesty and truth, since there is nothing in his directions for bevel-work, which he parades so much about, but what an apprentice boy may be taught by seven hours proper instructions. With respect to the geometrical view of the Five Orders which he has given, these are useful, and the only thing in his book which at this day is worth notice, as all his chairs are nearly as old as Chippendale's, and seem to be copied from them.

The succeeding publication to this seems to be Ince's and Mayhew's Book of Designs in Cabinet and Chair Work, with three plates, containing some examples of foliage ornaments, intended for the young designer to copy from, but which can be of no service to any learner now, as they are such kind of ornaments as are wholly laid aside in the cabinet branch, according to the present taste. The designs in cabinets and chairs are, of course, of the same cast, and therefore have suffered the same fate: yet, in justice to the work, it may be said to have been a book of merit in its day, though inferior to Chippendale's, which was a real original, as well as more extensive and masterly in its designs.

In looking over Ince's book I observed two card-tables with some perspective lines, shewing the manner of designing them. These, so far as they go, are a useful attempt; but cer-

tain it is to me, from some experience in teaching, that no person can have the smallest acquaintance with the principles of perspective, merely from seeing two or three lines joined to a plate, without proper instructions by letter-press. It is true, a description is given of these lines in the 7th page of his book, but not equal to what is absolutely requisite to such as have no previous acquaintance with the art; and those that have, will not require that which can give them no assistance. Properly speaking then, what is done in this book, relative to perspective lines, can only serve as a hint to the workman, that this art is essential in designing.

In the year 1788 was published, “ The Cabinet-maker’s and Upholsterer’s Guide.” In which are found no directions for drawing in any form, nor any pretensions to it. The whole merit of the performance rests on the designs, with a short description to each plate prefixed. Some of these designs are not without merit, though it is evident that the perspective is, in some instances, erroneous. But, notwithstanding the late date of Heppelwhite’s book, if we compare some of the designs, particularly the chairs, with the newest taste, we shall find that this work has already caught the decline, and perhaps, in a little time, will suddenly die in the disorder. This instance may serve to convince us of that fate which all books of the same kind will ever be subject to. Yet it must be owned, that books
of

of this sort have their usefulness for a time; and, when through change of fashions they are become obsolete, they serve to shew the taste of former times.

I shall now conclude this account of books of designs with observing, that in the same year was given a quarto book of different pieces of furniture, with the Cabinet-maker's London Book of Prices; and, considering that it did not make its appearance under the title of a Book of Designs, but only to illustrate the prices, it certainly lays claim to merit, and does honour to the publishers. Whether they had the advantage* of seeing Heppelwhite's book before theirs was published I know not; but it may be observed, with justice, that their designs are more fashionable and useful than his, in proportion to their number.

Upon the whole then, if the intended publication, which now petitions your patronage and support, be so compiled and composed as fully to answer, and also to merit, the title which has been given to it, I think it will be found greatly to supply the defects of those books now mentioned, and will appear to

* This is not meant to insinuate any disrespectful idea of the abilities of those who drew the designs in the Cabinet-maker's Book of Prices. I doubt not but they were capable of doing more than Heppelwhite has done, without the advantage of seeing his book: and it may be, for any thing I know, that the advantage was given on their side.

be on as lasting a foundation as can well be expected in a work of this kind. For instance, the first part, which provides the workman with geometrical lines, applied to various purposes in the cabinet branch, cannot be altered any more than reason itself. The same may be said of Perspective; the subject of the second part. This art, being founded on Geometry and Optics, may be improved in its practice, but its fundamental principles can never be altered, any more than the nature of vision and those immutable principles upon which good sense is founded.

With respect to mouldings and various ornaments, the subject of the third part, it is granted that these are of a changeable kind. Yet it is pretty evident that materials for proper ornaments are now brought to such perfection as will not, in future, admit of much, if any, degree of improvement, though they may, by the skill and touch of the ingenious hand, be varied, *ad infinitum*, to suit any taste at any time. It may be necessary to observe also, that this book will have the advantage of exhibiting the present and newest taste of work; for, whilst we are teaching the practice of Perspective, the examples given shall both shew the necessary lines for designing, and likewise represent, in different situations, some useful or fashionable piece of furniture. To this advantage we shall also add another, namely, that every example in pieces of furniture will have the geometrical

metrical dimensions laid down on the ground, or other scale lines adapted for that purpose. So that no person, however ignorant of Perspective, shall be liable to mistake the Perspective for the geometrical measurements, or be at any loss to know the general sizes of such pieces as shall be introduced*. And we may say, with respect to changes of fashions, that he who is properly acquainted with lines, versed in Perspective, and sufficiently practised in ornamental drawing, will, from a few hints, be able, at any time, to turn his hand to any fashion.

Lastly, I would entreat leave to remark, that, as the publication of this work will be attended with very great expence, the accomplishment of my design will principally depend upon

* The Cabinet-maker's Book of Prices advertises those who are ignorant of Perspective to take care how they apply their compasses to the designs, lest they should make any mistake about the sizes. But I do not see how this can be avoided by such as are ignorant of the art, since there are no directions given how to apply them, nor necessary scales for the purpose of obtaining the true measurements. They have given a scale for the front of their designs, which serves to give the height and length of such of them as are drawn geometrically in front, but can be of no service in finding the width of a piece of work drawn in perspective; because its apparent breadth is much narrower than the real or geometrical one. And it may be further observed, that we cannot determine the height of a book-case merely by a ground scale, when the book-case is drawn in perspective, because then the top part recedes or falls back from the front, it is therefore in appearance lower than the real height. For which cause, if any person was to apply the compasses for the height of a piece of work of the above kind, they must be totally deceived respecting its height. Therefore, in the following work, every difficulty of this kind shall be obviated, and proper directions given how to avoid these errors, and to apply the compasses, so as to obtain every necessary dimension.

the

the encouragement I meet with from you as subscribers; and I hope, on my part, that neither care nor assiduity will be wanting to give you all possible satisfaction, and to render the book as complete as is in the power of,

GENTLEMEN,

Your humble Servant,

THOMAS SHERATON.

I N T R O D U C T I O N

TO

PART THE FIRST:

CONTAINING SOME PRELIMINARY OBSERVATIONS.

GEOMETRY literally means, to measure the earth*, but in practice is applied to many arts and trades, as well as science in general. With respect to that part of it which becomes useful to us, it is pleasant and easy, readily understood, and of a mechanical nature; so that no workman need to be shocked or frightened at the idea of learning such geometrical lines and figures as shall be considered in the subsequent pages. Nor is it requisite to the workman to begin with the usual definitions in geometry, as these would be foreign to my plan, and unnecessary

* Geometry; from $\gamma\eta$ *gê*, the earth, and $\mu\epsilon\tau\rho\omicron\nu$ *metron*, to measure.

for him to know. For instance, he needs not be told that a point is without parts or magnitude, that a line is length without breadth, or that the terms of a line are points, &c. &c. These, and a number of others of this kind, are known by the common understanding of every one. I shall therefore confine myself to such particulars as every candid workman will at once pronounce useful, and which may be applied to the practice of some parts of the ingenious art of Cabinet-making. Yet, from what I have here advanced with respect to geometrical definitions, I would not be understood as speaking disrespectfully of them, much less to deny their usefulness to such as learn geometry regularly. It is impossible to proceed without these, when this ancient and divine science is taught as the groundwork of mathematical learning. We might as well attempt to teach logic without a method of arranging or distinguishing ideas, or arithmetic without the powers and properties of numbers, as geometry divested of its chain of definitions and axioms, &c. by which at length we arrive to the certain knowledge of truth, and are able to demonstrate it to others. But, on the other hand, as it is possible for a man of sound sense to reason well without knowing the rules of logic as they are taught in fine and regular systems, so, I apprehend, it is also possible for a workman of no learning, but what is common, to attain to a useful knowledge of geometrical lines, without the trouble of going through a regular course of Euclid's definitions and demonstrations,

monstrations, &c. And we may justly say of his definitions and demonstrations, the sound of which so often alarming the ears of the ignorant, that they are, as a certain writer observes, " Built upon a few principles of common sense, without which the most domestic and simple negotiations of life cannot be transacted, and that, what they shun as subjects too sublime and intricate for their comprehension, are only the most familiar truths made artificial by regularity and disguised by a technical language."

Upon this view of Geometry, I shall now proceed to the consideration of such Problems as every workman of tolerable capacity will easily understand, and find advantageous to him.

And, for the sake of making every part of this book as intelligible and useful as I am able, I shall, in the course of proceeding, explain such * technical terms as may be necessarily used in the subsequent pages, and which, for propriety's and brevity's sake, cannot well be avoided on subjects of this nature. And, in attempting this, I hope not to incur the disagreeable title of a pedant; as I pretend not to give these explanations as the produce of my own skill in Etymology, but shall recommend them to the reader as they are found in the writings of

* From *τεχνη* *technē*, art; which belong to the terms and rules of arts and sciences.

men of unquestionable abilities in this way*. Besides, when it is considered that the following work is not written for the learned, but such as may want some assistance in the derivation of particular words used in Geometry, Architecture, and Perspective, in order to fix their real meaning more lastingly on their memory, it is presumed that this consideration alone will, in the view of the candid, sufficiently apologize for me. As for those of an opposite cast of mind, it is not easy to say what would please, or what displease, them.

As Chambers, Johnson, Bailey, Parkhurst, Lemon, &c.

THE
CABINET-MAKER AND UPHOLSTERER'S
DRAWING-BOOK.

PART I.

CONTAINING NECESSARY INSTRUCTIONS FOR OBTAINING
THE KNOWLEDGE OF SUCH LINES AS ARE USED IN BOTH
BRANCHES.

SECT. I.

*On dividing a Line into any Number of equal Parts—raising a
Perpendicular on a given Point—and the Method of dividing a
Frieze or Pilaster into Flutes and Fillets.*

* PROBLEM I. PLATE I. FIG. I.

A RIGHT line being given, to divide it into any number of equal parts. The line to be divided is 7.I, which is to be divided into 7 parts.

Operation.—First, From 7, on the given line, draw a right line at pleasure, making any angle with the line to be divided.

* Problem, *προβλημα*, *problema*, “from *βαλλω*, *ballo*, to throw, and *πρὸ*, *before*, i. e. to propose, or set before: a proposition relating to practice, or which proposes something to be done; as to bisect a line given, to draw a circle through any three points;” or, as in the present case, to divide a line into any number of equal parts.

Then with the foot of your compasses, fixed on 7, turn the arch * 1.8, and, without any alteration of the instrument, place its foot in 1, and turn the arch 7.9 at pleasure.

Second, Take the space 1.8, and place it on the arch 7.9 drawn indefinitely†. Then from 1 to 9, draw a right line, which will be parallel, to the line 7.8.

Thus far it should be observed, that the problem teaches to draw two lines parallel, both with dispatch and accuracy.

Lastly, with your compasses, opened at random, lay on the divisions 1, 2, 3, 4, 5, 6, on both lines, first from 1 to 9, then from 7 to 8, and by drawing lines from each correspondent point, the given line 1.7 will then be divided as required.

A little reflection will point out the reason of this, if we consider that the lines 7.8, 1.9, are perfectly parallel to each other.

For if the divisions laid on each line be greater or less than those sought for, yet lines drawn across to each respective division will cut the line to be divided in the same points; because

* Arch, from *arcus*, a bow, *Lat.* and, when used in Geometry, implies "any part of a circumference of a circle."

† That is, without bounds or limits.

what is lost or gained on one line, by these uncertain divisions, will be regained or lost, when the same uncertain divisions are placed the contrary way on the other parallel line. This is clearly exemplified in the figure by the small dotted divisions on each line, which are shorter than the proper ones on the given line. Yet, if right lines be drawn through each corresponding dot, they will cut the given line as before.

The small dotted line drawn across, from the correspondent points near to 1.5, demonstrates this, and therefore it is unnecessary to say more.

PROBLEM II. FIG. 2.

To divide a frieze or pilaster, &c. &c. into any given number of flutes and fillets: the following method is a most certain and quick one.

1. Let *AB* be the supposed width of the pilaster required to be fluted.

Operation.—Draw the right line *CD* indefinitely. Take then two pair of compasses, one for the flutes, and the other for the fillets; and with the first opening of your compasses for the flutes, lay it on *CD*, and divide this uncertain opening *ab* into three. Again, take one of these three parts for each fillet, as *ca*, and repeat

repeat it on the line *C D*, first a fillet, then a flute, till you have the proposed number, which in this case is 5, (and always in pilasters should be an odd number*.)

Second, Extend your compasses from *c* to *d*, the whole space which the uncertain divisions include; and with one foot on *c* or *d*, turn the arches *E c* and *E d*, and from the point, where these two arches intersect as at *E*, draw right lines to *c* and *d*, which will then form an equilateral triangle.

Lastly, Draw lines from all the divisions on *C D* to *E* the angular point. After which, take *A B* in the compasses and turn the arch *e d*, and through the two sections *e d* draw a right line, then will *e d* be equal *A B*, and the pilaster or frieze will be divided in the most accurate manner as required.

PROBLEM III. FIG. 3.

To raise a perpendicular from any given point on a line as its base.

* Observe, any opening of one pair of compasses will do the whole business, if a previous calculation be made of the equal parts contained in all the flutes and fillets. Thus, in the present case, we say there are five flutes, allowing the space of three fillets to a flute, which make together fifteen; and the addition of six, the number of fillets in the pilaster, make twenty-one. Therefore lay on the compasses at random twenty-one times, and proceed as above.

Operation.

Operation.—Let G be the given point on the base line GV . Take then the * radius GO , or any other at pleasure, and turn the arch OS . Fix again your compass foot in O , and, without any alteration, intersect the arch at P . On P , with the same opening of the compasses, make another section at S , and from those points SP turn an arch each way, and their intersection will form a point perpendicular with the given point G , as required.

This may also be effected another way with more dispatch, but perhaps not always with equal accuracy.

Operation.—Let ME , Fig. 14, Plate 2, be the base, and E the point whence you would erect a perpendicular. With any opening of the compasses, and with one of its legs fixed any where out of the line, as at S , sweep the arch b, d till it cut the base line, as at b . Then from b draw bs through the center S , cutting the arch at d , and their section will form a point perpendicular to E , as required.

These problems may be very useful to an Upholsterer when he is laying down the plan of a room for a carpet, as it is not convenient always to take a square with him. Besides, by a good line, bradawl, and chalk, a perpendicular may be raised

* Radius, a right line drawn from the center of a circle to its circumference. This right line, I conceive, answers to the rays of light (in an optical sense), which, falling upon the eye every where in right-lined directions, form a horizon to our sight.

with more exactness than can be drawn on a floor by a square. But, as I intend giving some directions to the Upholsterer how to lay down a room in an accurate manner, so that a carpet may be properly cut by his plan, I shall at present say nothing more on this subject.

PROBLEM IV. FIG. 4.

To draw a perpendicular line by a scale of equal parts, as by a common rule, or by a rod divided.

Operation.—Let the line GV be the line required to raise a perpendicular from. Let V be the proposed point, and from any scale of equal parts lay down ten of those parts from the point V towards G . Take then six of those parts (or six inches of the common rule) and turn the arch 1.2 at pleasure. Again, take ten parts, or ten inches of your rule, and place the end of the rule or rod on the eighth of those ten parts or inches, and with the other hand, by a pencil, intersect the arch 1.2 , by which a point will be gained exactly perpendicular to V , as required.

This problem will be of use to the Cabinet-maker and Upholsterer when neither square or compasses are at hand. For instance, if a Cabinet-maker would cut a board across perfectly square, without compasses, chalk line, or square, if he have but a rod, let him proceed thus :

Divide the rod into ten equal parts, and by this straight rod strike a line on the side of the board; then lay down ten parts on this line, and proceed as above.

S E C T I O N II.

On the Use of a common Case of Instruments, together with some Geometrical Problems considered.

As the various instruments found in common cases are not commonly understood by Cabinet-makers and Upholsterers, and as the principles by which they are devised and constructed are purely geometrical, I think it necessary and useful to give an explanation of them, so far as they can any way assist the above persons, or others, in the practice of drawing.

The first thing that needs be noticed is a scale of feet and inches.

The intention and use of a scale is to reduce the real measurements of any object to a convenient proportion, so that it

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may

may be represented on a sheet of paper, &c. with as much exactness as if it were drawn at full size*.

A scale of feet and inches should be used when we represent any piece of furniture either geometrically or perspectively, because such a scale answers to our common rules; but when we lay down any figure by the help of mathematical instruments, then a scale of tenths must be used.

On the Construction and Use of a Scale of Feet and Inches.

To understand a scale of feet and inches, draw seven lines parallel to each other, and at equal distances, as in Plate I. Fig. 9. Then, as on the line 1, 2, 3, lay down as many divisions for feet as will comprehend the largest dimension of the piece you would draw. Secondly, divide one of these parts, which you suppose to be a foot, into twelve equal parts, the number of inches in a foot; to effect which, divide that part or foot into two equal parts, as at 6: draw then the two lines 6.1, 6.12, and the foot will be divided as required, and in the most ac-

* The term Scale seems to have been derived from the steel-yard; and its notches or divisions marked on the beam, to adjust the different degrees of weight by.

curate manner, as is clearly demonstrated by the small divisions on the line 12.

To use the Scale.

IF you want one foot one inch, place your compass foot on the second line from the bottom, over 1, and extend the other foot to No. 1 on the same line. Again; if you want one foot two inches, then place the foot of your compasses on the third line from the bottom, over 1, and extend the other foot to No. 2 on this line. Lastly; if you want three feet seven inches, place one foot of your compasses on the sixth line, over 3, and extend the other foot to No. 7, and so on for any other number of feet and inches that may be required.

On the Construction and Use of a Scale of Tenths.

Draw eleven lines parallel to each other, and at equal distances, as in Fig. 10, Plate II. Afterwards lay down eleven divisions, as you see on the scales found in cases of instruments (I have divided mine only into six, for want of room). Take one of those divisions or parts, and by Prob. I. Fig. 1, divide it again into ten equal parts, placing the divisions on the bottom and top line. Then from the point *o* draw a line to the point before 2 on the top line, and so on, as the Figure shews. When all these lines are drawn, there will then be precisely one hundred equal

parts, distinguishable by the dots on the several angles of the rhombs, because, being divided into ten each way, they multiply into one hundred, by which we shall be able to take any tenth or any hundredth part of the large divisions 1, 2, 3, 4, &c.

To use this Scale.

IF you want one of the large divisions and one 10th, this is ascertained by placing one foot of your compasses on No. 1, and extending the other to the first division beyond 0, and so on, as may be required. Again, if you want one large division (which may be called a foot) and nine hundredth parts of a foot, place one foot of your compasses on the line 9, and extend the other to the first tenth on that line, and you will then have one foot and nine hundredth parts as required. Lastly, if you want five feet five tenths of a foot and five tenths of an inch, place your compass foot on No. 6, on the right hand end of the scale, which is the sixth line from the bottom, and extend the other foot to the sixth dot on the same line, and the required dimension will be obtained. It will be evident therefore, by a little reflection on the nature of this scale, that any tenth part of a foot, and any tenth part of an inch, may be accurately taken.

The scale of chords comes next under consideration. This scale is commonly found on the contrary side to that whereon

whereon the scale of tenths is marked, which we have now described. The use of it is to lay down angles of different degrees, and to divide a circle into various proportions and parts.

The Construction and Use of a Scale of Chords.

1. Open the compasses to sixty degrees on the scale marked CHO, Fig. 11, Plate II. and by this opening describe a semicircle, as BDA, Fig. 12. Then if the arch BD be divided into ten equal parts, those parts 10, 20, 30, &c. will answer to 10, 20, 30, &c. on the scale of chords, Fig. 11. Hence, if you want to divide a circle into twelve parts, take thirty from the scale of chords, and apply the compasses to the arch BD at 30, then BD will contain it three times, and consequently the whole circle will contain it twelve times. If again you want this circle divided into eight equal parts, then from the scale take the chord of 45, and apply it to the arch BD at 45, and this will divide the quadrant into two equal parts, and therefore the whole circumference may, by the same opening, be divided into eighths. In this manner any other division of a circle may be certainly known at once, which a little thought will easily make clear, and therefore it is unnecessary to give any other example on dividing a circle into equal parts.

This

This scale may likewise be used in laying down any angle* not more than ninety degrees. Draw the line $G o$, Fig. 16, at pleasure; then take the chord 60° and sweep the arch oo at pleasure. With your compasses take the chord $37^\circ\frac{1}{2}$ and place it on the arch oo ; draw the right line $G o$, and you have an angle of thirty-seven degrees and an half, and so of any other, to ninety degrees.

On the PROTRACTOR †.

THE Protractor is a semicircle of brass, divided into one hundred and eighty degrees, by the help of which we may describe an angle of any assigned quantity whatever, and likewise measure any angle already laid down.

Let the arch, divided into one hundred and eighty equal parts, on the line $A B$, Fig. 6, Plate I. be considered as the brass protractor, which is found in common cases of instruments.

* Angle. "This seems to be from *ἄγκυλος*, *ankulos*, the bending of the elbow;" and in Geometry, implies the point in which two lines meet: but the quantity of an angle is the space comprehended between the two lines meeting in a point, as oo , Plate II. Fig. 16, and its proportion is expressed by degrees; which term, Degree, means simply the three hundred and sixtieth part of a circle, whether great or small.

† Protractor, from *protractum*, "to draw out in length;" accordingly, by the help of this instrument we may draw out the legs of a triangle to any length we please.

First,

First, observe the center of the protractor, distinguished by a small notch on the diameter, answerable to 6, on A B, Fig. 6.

2d. Let it be required to lay down an angle of ninety degrees, and let A B be considered as the base. Then place the small notch on the diameter of the brass protractor, upon 6, on the line A B, and make a mark exactly over 90; consequently a line from 6, the center, to 90, the vertical* point, will form an angle of ninety degrees, or what we commonly call a square:

Again, if an angle of forty-five be wanted, proceed as before, and make a dot over 45; to which draw a line from the center, and it will be an angle as required; and so of any other to any quantity. This is so plain, that to say more would be needless. It may however be proper to observe, that the quantity of any angle already laid down may also be found by the protractor as follows.

Let G o o, Fig. 16, Plate II. be the angle to be measured. Take the Radius, or half diameter of the protractor, and sweep the arch o o; then open the compasses to o o, and apply them to the degrees marked on the instrument, and it will immediately be seen how many of those divisions are contained in the angle, which number of divisions are called the quantity of the angle.

* *Vertical*, "placed in a direction perpendicular to the horizon."

On the SECTOR.*

The Sector is a most universal instrument, and used for various purposes in the different branches of mathematical learning. Nor is it without its usefulness in the art of drawing, and therefore those who are concerned with designing ought, in some measure, to be acquainted with it.

To this end let us first consider the most simple part of it, which is, to divide any given right line into any number of equal parts.

The line to be divided by the sector is 7.7, Plate I. Fig. 5, which is to be divided into seven.

First, Look for the line of lines on the sector, which may be found by observing two brass centers marked with L on each limb of the instrument.

Second, Take the length of the line 7.7 in your compasses, and place one foot on the point 7 on the line of lines, and opening the sector, extend it till the other leg of the compasses co-

* Sector; it is so called because, when it is opened, it comprehends a portion of a circle between two semidiameters, making an angle at the center, as O A 4, Plate I. Fig. 6.

incides with the point 7 on the other limb of the instrument, as Fig. 5 clearly expresses. In this position keep the sector, and moving the compasses to 1.1, which is the nearest figure to the center of the instrument, contract their legs till you take the opening 1.1, which, if correctly done, will be one-seventh part of the line 7.7, as proposed. Perhaps it may be required to divide a line into fourteen; if so, then as there are only ten on the line of lines, you take half the length of the given line in your compasses, and place their legs on the points 7.7 as before; and, as this opening is but half the length of the line to be divided, the compasses must be contracted to 1.1 as before, and then the line will be divided into fourteen, because twice seven is fourteen.

In this way any right line, to be divided into any number of parts, may be brought upon the sector. To make this still more plain, let it be proposed that a line twice the length of the line 7.7 is to be divided into twenty-eight equal parts. Take the line 7.7 in your compasses, and proceed in all respects as before, except one thing, i. e. in place of contracting the legs of the compasses till they touch the points 1.1, you must draw them in till they touch the lines at half the distance of 1.1 from the center, as the dark line next the center of Fig. 5 shews. This opening of the compasses will turn fourteen times on the

line 7.7, consequently it will turn twenty-eight times on a line twice its length.

Of the Line of Polygons on the Sector.*

This line is intended to divide a circle into equal parts, by which any kind of Polygons, from a pentagon to a duodecagon, may be formed. Hence it is distinguished by the letters POL on this instrument.

Let it be required to divide the circle, Fig. 8, into five, which forms a Pentagon. Take the radius or half diameter of Fig. 8, and opening the sector, as described by Fig. 7, place the compass on the point 6.6, marked radius. In this position keep the sector, and, without any variation of the instrument, you may divide the circle 8 from 4 to 12. In the case before us it is into five; therefore take the compasses from the points 6, and extend them till they touch 5.5, and this opening will go five times on the circle 8, as will be evident if you take 5.5 in your compasses from Fig. 7, and apply it to Fig. 8.

Lastly, if you want the circle 8 divided into twelve, by which to form a Duodecagon (see Plate II. Fig. 26), the sector still remaining unaltered, place your compass legs on the points

* " Polygon, from *πολυς*, *polus*, many, and *γωνια*, *gonia*, a corner, having many corners or angles."

12.12, and apply them to the circle 8, and it will be divided as required.

Observe also, that a geometrical square may, by the same means, be inscribed in any circle; for by keeping the sector extended as before, and opening the compasses till their legs touch on 4.4, this opening will turn four times on the circle 8, and therefore will form a square.

How this line of Polygons is divided so as to proportion any circle in this manner, will easily be understood by considering Fig. 6.

Describe a circle of any radius, and draw the diameter A, B. Divide one-half of the circumference into one hundred and eighty equal parts, called degrees, and from 90° draw the arch 4 from the center A, then will the lines A O and A 4 represent the limbs of the sector, Fig. 7, and 4 on Fig. 6 will answer to 4 on Fig. 7.

Next draw the arch 5 from 72° , and from the center to 5 will be the chord of 72° , the degrees contained in the side of a Pentagon, answerable to 5.5 on Fig. 7.

Proceed to the arch 6, and observe, that this is the radius

of the circle, and is always equal to the chord line 60° , and therefore contains a length equivalent to the side of a Hexagon, or a six-sided figure, and agrees with 6.6 on Fig. 7.

After these remarks, I think it unnecessary to go through each chord line; only the reader should observe, that I have marked such chords as have fractional parts on the sine lines, or those drawn perpendicularly from A, B. For instance, the chord for a Heptagon is fifty-one degrees and three-seventh parts of a degree; and the meaning of three-seventh parts is nothing more than to divide a degree into seven, and to take three of those parts and add to fifty-one, which is exactly the side of a circle divided into seven, called a Heptagon. These parts are easily found and proved by dividing three hundred and sixty, the number of degrees contained in a whole circle, by the quantity of sides contained in any Polygon, for then the quotient will be the number of degrees which are in the arch of every such chord line.

Thus for a Heptagon; divide three hundred and sixty by seven, then will the quotient be fifty-one degrees and three-sevenths, equal to the side of a heptagon.

Of the Line of Chords on the Sector.

The Chords on the fixed scale have already been considered (see page 29). These chords are limited to one circle, which, to suit that scale, must always be drawn by the compasses extended to sixty degrees: but the scale of chords on the sector is unlimited, because the chords of circles of various radiuses may be found according as the limbs of the instrument are more or less extended.

The line of Chords is on the same side of the sector with the Polygons, marked with *c* nigh to a brass center on each limb: and if it be required to find the chord of thirty of any circle, take the radius of the given circle, and open the sector till the compass legs coincide with those brass centers at 60.60, then contracting the compasses till their legs touch 30.30, the required chord line will be found. In this manner proceed in any other case; always observing that the semi-diameter of the circle must limit the opening of the sector at the brass centers.

By this line of Chords on the Sector it is evident that a circle may be divided into seven hundred and twenty equal parts with considerable dispatch and great accuracy.

Of the Line of Sines on the Sector.

A Sine is a right line drawn from one end of an arch perpendicularly upon the diameter drawn from the other end of that arch, as the perpendicular line 90, drawn from the diameter BA, Fig. 12, Plate II. is the sine of the arch BD; and so likewise all the other perpendicular lines, as 1, 2, 3, 4, 5, &c. on the line BA, are sines of so many different portions of the arch BDA.

The line of Sines on the sector, which Fig. 13 is intended to represent, is marked ss high 90.90, with two brass centers, one on each limb of the instrument. The several divisions on this line, marked 10, 20, 30, &c. answer to these perpendicular lines 1, 2, 3, 4, 5, &c. on the line BA, Fig. 12, and the different situations of those perpendicular lines are found by dividing the arch DA into nine equal divisions. Perpendiculars being then drawn from each respective division on the circumference of the circle to the diameter AB, they are of course denominated sines of 10, 20, 30 degrees, and so on.

To draw an Oval by the Sector.

First, Draw a circle that will comprehend the longest diameter of the oval you wish to describe, as the circle BDA, Fig. 12. Divide the quadrant DA into nine equal parts.

Second,

Second, Take then the shortest diameter in the compasses, and place one foot on the sine 90° , and open the sector till the other coincides or touches 90° on the other limb of the instrument. In this position keep the instrument fixed, and contract the compasses till their feet touch the sine $80^{\circ}.80^{\circ}$; transfer this opening of the compasses to the perpendicular line 8 at 80, which mark with the point of a pencil.

Proceed to the sine 70, keeping the sector still in the same position, and, after contracting the compasses till their legs touch 70.70 on the sector, transfer this opening to the perpendicular line 7 at 70° , and so on of all the rest to the sine 10, by which will be obtained nine points, contracted in due proportion* from the arch D, A; and a line, passing through each of these points, and drawn by a steady hand, will form an ellipsis perfectly true and agreeable, as is evident by the figure.

From what has been said, I presume it will easily be understood by every one how to proceed with the other quarters to complete the whole ellipsis.

* This is evident by observing, that as a right line drawn from 45 on the tangent line to the center 9, cuts the arch D A in the degree 45; so likewise will a right line drawn from 10 on the tangent line to the center, cut the elliptic arch 90 A in the same degree.

A circle may also be described by the sector upon the same principle that an ellipsis is drawn by it. This, in itself, is not very necessary to be known, because when we have no compasses, no use can be made of the sector, and when we have them by us, they are the best instrument for drawing a circle. However, since what belongs to the drawing of a circle by the sector, partly belongs to the describing of an ellipsis by this instrument, I shall venture upon this Problem.

Operation.—Draw a right line at pleasure, of length enough to contain the diameter of the circle to be drawn. Bisect * this line, and draw a line at right angles with it of the same length. Take then the semi-diameter of the circle, and place it on the lines each way.

Open the sector, and on the line of sines proceed as before to take the sine 80. Transfer this to any semi-diameter, as *g A*, Fig. 12, which will extend to 1 on that line. Then proceed to take the sine 70, and transfer this also, which will extend to 2 on that line. Proceed to the sine 60, and this opening will ex-

* A line is said to be bisected when it is divided into two equal parts, from “*bis* and *sectum*, to cut in two;” an operation which is easily performed by sweeping two arches from the extremities of the line to be thus divided; as from *b* and *d*, in Fig. 14, where two arches intersect, which if a line be drawn from these intersections, it will both bisect the given line, and will at the same time be drawing one at right angles to it.

tend to 3 on the same line, and so on, till you take the fine 10, which will extend from 9 to 8. The same must be done on the other radius, as you take the fines from the sector. Having thus divided one diameter, draw perpendicular lines from each division each way at random. Lastly, take the same fines again from the line 9 A, and place them upon their respective fines; that is, take from 9 to 1, which is the fine 80, and place this upon the perpendicular line 8 at 80, and so of all the rest, and they will form thirty-six points for the whole circle; through which points, if a line be correctly drawn, the circumference of a complete circle will be produced with as much accuracy as when we draw the circumference of an oval in the same manner.

*Of the Tangent * Line on the Sector.*

A tangent is a right line drawn perpendicular on the extremity of some radius, touching the circumference of the circle, but not cutting it, as A 45, Fig. 12.

This line is of use to divide the circumference of a circle into any number of equal parts, and may be found on the sector by a brass center on each line, marked T. To this line there

* Tangent, from *tangens*, Latin, touching.

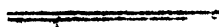
is added another of the same kind, marked T on each limb, but without a brass center to it.

To divide a circle by this line, proceed thus :

Take the radius of the circle to be divided, and with this opening, place the compass legs on each line T, marked 45.45, then will the sector be prepared for finding every degree of a circle up to 45. This is clear ; for if the radius be laid down on the tangent line, Fig. 12, as at 45, a line drawn from 45 to 9, the center, will cut the arch DA at 45 degrees, as is obvious by inspection. Thus the circle may be divided into eight, since forty-five is the half of ninety, consequently the eighth of three hundred and sixty. The sector being still in the same position, if you want to cut the arch DA at 10 degrees, contract the legs of the compasses till they coincide with 10.10 on the tangent line, and transfer this on the tangent line A 45, and a right line being drawn to the center as before, it will cut the arch DA at 10. Hence if the arch DA is required to be divided into nine, the extent of the compasses at those ten degrees will turn nine times on the arch DA.

It has already been observed, that there are two tangent lines on the sector. The tangent line which has not the brass center, is to increase that which has one up to 75, as it is marked
on

on that line. When therefore any degree above forty-five is wanted, take the radius of the circle to be divided, and open the sector till the compass legs touch 45 on the second tangent line on each limb; then will the instrument be prepared for taking the tangent of any degree up to seventy-five, by proceeding in the same manner as on the first tangent line.



S E C T I O N III.

On the Names and Properties of various useful Geometrical Figures of the Superficies.

To have some knowledge of the names of useful geometrical figures is certainly of advantage to every one, and especially to such persons as are concerned with drawing or making pieces of work of the like forms.

It is certain from experience and matter of fact, that many, not acquainted with names of this kind, are obliged to use a dozen words and signs when one would be sufficient.

Besides, a knowledge of these names, together with an acquaintance with the general properties and manner of drawing such figures, must certainly be considered as an introductory step to a more advanced knowledge of Geometry, by those young men who intend to rise higher in this sublime science, than can be expected to be taught in a drawing-book.

I shall therefore begin with the names and properties, and afterwards describe the construction, or manner of drawing, the most generally useful figures.

*Of the Superficies**. (See Plate II.)

No. 1, is a Geometrical Square, so called because it has four sides of equal length, and four right angles.

No. 2, is a Parallelogram. This figure receives its name from its opposite sides and ends being all parallel to each other.

No. 3, a Rhomb, which is properly a geometrical square moved out of its position, since all its sides are equal, but not its angles, two of them being acute, and the other obtuse.

* Superficies, *superficies*, Lat. the surface or outermost part of any thing, and in Geometry are such figures as are bounded by one or more lines, or an extension which has length and breadth, but no thickness.

No. 4, is a Rhomboides, a figure which bears the same affinity to a parallelogram that a rhomb does to a geometrical square. A rhomboides has its sides and ends parallel to each other, but its angles differ the same as those of the rhomb; and therefore a rhomboides is a parallelogram moved out of its proper form.

No. 5, is a Trapezoid, which has four sides, two of which are parallel, and two not; the same as the seats of some chairs.

No. 6, a Trapezium, containing four sides, which are all unequal, and none of them parallel.

These six figures, being all of them bounded by four right lines, are, by geometricians, called quadrangular or quadrilateral plain figures.

Of various Triangles.

No. 7, is an Equilateral Triangle, so called because all its sides are equal to one another; and, as every triangle contained under three equal sides, whether circular or mixed, are called equilateral, so the figures 11, 12, 15, are also of that denomination.

No. 8, is a Right-angled Triangle, because two of its sides are perpendicular to each other, and consequently make an angle of ninety degrees, as the line 9.90° , Fig. 12, is perpendicular to BA , therefore $A.9.90^\circ$ forms a right-angled triangle, comprehending a part of a circle equal to ninety degrees.

In all right-angled triangles, the sides containing the right angle are called the Legs, as the sides $9A$, $A.45$ are the legs of the triangle $9A, 45$, in Fig. 12; and the opposite side to the right angle is called the Hypothenufe, as the line 9.45 , in the triangle $9A, 45$, is the hypothenufe side of that triangle.

“The perpendicular height of any triangle is a line drawn from the vertex to the base perpendicularly:” thus if the triangle PEO , Fig. 15, be proposed, PO must be considered as its base, and consequently E its vertex; and if from E you draw the line EP perpendicularly to PO , then the line EP is the height of the triangle EPO , standing on PO , its base.

No. 9, is a triangle called Scalénous, because none of its sides are equal, nor its angles alike in quantity. A Scalene Triangle is composed of two kinds of angles, one obtuse, and the other acute; so also a right-angled triangle is composed of two, a right one, and an acute.

All other triangles are of the acute kind.

An obtuse* angle is one that is greater than ninety degrees, or more than what we call a square, as a line from 9 to the point D, Fig. 12.

An acute angle is less than ninety degrees, as a line from 9 to 10, considering the side 9 A as their base.

No. 10. This triangle is called Isosceles, because two of its sides are equal in length, as G 0, G 0, Fig. 16; or if the sector be opened, a triangle of this kind is fitly represented by it.

These four triangles, being bounded by three right lines, are called rectilineal plain triangles; and in general, these are placed before the quadrilateral, or four-sided figures, because by geometricians they are considered as more simple, having only three sides: but as triangles generally appear more out of the way to workmen, I have assumed this liberty to place them after four-sided figures.

Of mixed Triangles.

Of this kind are numbers 11, 12, 13, 14, and they are called mixed triangles, because some of their sides are right lines, and

*. Obtuse signifies flat or blunt, and acute sharp or cutting.

some curved ones. Three of these are equilateral, or equal-sided, if measured by a right line; and No. 14 is a scalene triangle by the same rule, as none of its sides are equal. The sides of these mixed triangles that are round, are called convex*, but those that are hollow, as No. 13, 14, are called concave.

Of Spherical † Triangles.

A spherical triangle is one that is curved on every side, as No. 15 and 16. These are both of the equilateral kind, because their sides may be bounded by right lines of equal length.

Of Mixtilineal Figures.

No. 17, is of this kind; and every other figure that is bounded both by right and curved lines is called mixtilineal.

Of these figures some are regular, and some irregular.

When a figure of this kind is composed of equal curved and equal right lines, then it is called a regular compound mix-

* Convex is properly applicable only to any solid that has a curved or swelled surface, and concave is the contrary.

† Spherical, something like a sphere or globe.

lineal figure; but when its sides and ends are formed of unequal curved and unequal right lines, then they are called irregular compound mixtilineal figures.

Of this sort is No. 18.

Of Polygonal Figures.

All Figures bounded by more than four right lines* are termed Polygons.

The figures included between No. 19 and 26 are all of this denomination. But each of these figures has its particular name from the number of the sides of which it is composed.

No. 19, is therefore called a regular Pentagon*, because it is bound by five right lines of equal length; but if any of those lines were unequal in length, then it would be termed an irregular Pentagon. The same distinction is applicable to any other of these figures in such cases.

* Pentagon, from *πεντε*, *pente*, five, and *γωνια*, *gonia*, a five-cornered figure. The other Polygons have all their particular names formed in the same way, from the Greek numeral adjectives.

No. 20 is termed a Hexagon,	} because it has {	6 fides or angles,
21 a Heptagon,		7
22 an Octagon,		8
23 a Nonagon,		9
24 a Decagon,		10
25 an Undecagon,		11
26 a Duodecagon,		12

No. 27, is a figure so well known that it is unnecessary to say any thing about it.

The same may be said of the Semi and Quadrant, Nos. 28 and 29, the one being an half, and the other one-fourth of a complete circle.

No. 30, is called the Greater Segment * of a circle, because it is the greatest part of a circle cut in two by a right line; and of course No. 31 is the Lesser † Segment, because it is not equal to a semi. But if we speak of a segment without regard to comparison, it is a figure contained between a chord and an arch of a circle.

* Segment, from *segmentum*, a piece cut off.

† Lesser. This way of forming the comparative adjective is by Dr. Johnson and Lowth considered as barbarous; but as custom has so long prevailed in the use of it, and as the ear seems to prefer lesser rather than less, I thought it would suit the readers best to retain it.

No. 32, is an Ellipsis *, commonly called an oval. This figure may be considered, in one view, as produced by the section of a cone, by a plane cutting both sides of the cone obliquely to its base. In this case the ellipsis produced must be irregular, since a cone is a solid which terminates to a point at the top; and therefore any section oblique to its base must produce an oval broader at one end than the other. To demonstrate this, nothing more is requisite than to get a piece of wood turned in the shape of a sugar-loaf, and let it be sawn across in a sloping direction from the bottom of it, and the surface of the cut will be an irregular oval. But if a cylinder be cut oblique to its base, there will then be produced an Ellipsis perfectly regular, and alike at each end.

It may also be observed both of a circle and an oval, that they are the only regular superficies that are bounded by one line; and those which are bounded by two, are their respective segments: as Figures 28, 30, 31, 33, 34.

No. 33, is the Semi-ellipsis, or Half-oval; and it is said to be on the transverse diameter, when the right side is equal to the

* Ellipsis, from *ελλειψις*, *ellipsis*, a defect or omission. If a superficies be apparently round, but, on measuring it, if one of its diameters be found shorter than the other, there is then a defect, and we say that the figure is elliptic.

longest diameter; but when it is only equal to the shortest diameter, then it is said to be on the conjugate, as No. 34.

No. 35, is termed an Hyperbolic Figure. When a cone, Fig. 12, Plate IV. has a section parallel to its axis, the curved boundary produced by the section is an Hyperbolic Figure; and when its section is parallel to the sides of the cone, then the curved boundary produced is called a Parabolic Figure.

S E C T. IV.

Of the Manner of drawing various useful Geometrical Problems.

IN the preceding section, the names and some of the properties of the most generally useful superficies have been considered; and I shall now describe the method of drawing them. However, in doing this it will not be necessary to describe every particular figure, since the same operation for one will sometimes apply to various others.

PROB.

PROB. V. FIG. 14.

To draw a Geometrical Square.

By the second method of Prob. III. raise a perpendicular, as $E d$, Fig. 14, Plate II. then extend the compasses equal to the side of the proposed square.

Fix one foot in E , and sweep the arch $b d$, which will cut the line $E b$, $E d$, equal to the sides of its square. Lastly, from d and b , with the same opening of the compasses, sweep the other arches, and their section will form a perpendicular to the points b and d , by which the square is completed.

From what has been said, it will easily be understood how to draw a Parallelogram.

PROB. VI. FIG. 2 and 16.

To draw a Rhomb.

If the sides of this figure be intended to incline at an angle of sixty degrees, all that is necessary is to draw two equilateral triangles from their opposite bases: and to draw an equilateral triangle is nothing more than to take in the compasses the given side

side of the triangle, and from a right line turn an arch each way, as Fig. 2, Plate I. and their section, as at E, by lines drawn to it, completes the figure.

Then if a right line be drawn parallel to CD at E, and *cd* be laid on this line, supposed to be drawn, it will complete the Rhomb.

But if a Rhomb be required to be drawn, whose oblique sides are wanted to be inclined thirty-seven degrees and a half, take the radius of the protractor and from the center G sweep an arch, as *o o*, Fig. 16. Draw G *o*, and take from the protractor thirty-seven degrees and a half, and lay it from *o* to *o*. Let the right line G *o* be the given side of the Rhomb; and how the other sides are to be drawn, reason itself will dictate.

The Rhomboides, being of the same species of figure, is easily drawn by the same rule. Nor is it requisite to describe the method of drawing any other of the figures till we come to the Pentagon, because some of them are variable, and those that are not so, are drawn by the same rules that are applicable to the Square, Rhomb, and Equilateral Triangle.

PROB. VII. FIG. 19.

How to draw the Polygons.

To draw a Pentagon whose sides shall be equal to a given length, as the line 12.1, Fig. 19, Plate III.

. Operation.—Draw a right line 12.1, and take the side 12.1 of the proposed Pentagon. Place one foot of the compasses on 12, and with the other sweep the arch 1.1. Again, place the compass foot on 1, and sweep the arch 12.1, and through the point where these arches meet raise a perpendicular line, and continue it at pleasure. Divide the arch 12.1 into six equal parts. Take then the first of these parts, and sweep it to the perpendicular line downwards, as the figure clearly shews; and from this point on the perpendicular line extend the compasses to 12, which will be the radius of a circle that will contain 12.1 five times: therefore, with the compasses thus fixed, describe the circle, Fig. 20, and it will admit of 12.1 five times, forming a regular Pentagon.

And here it should be observed, that what has been done in this Problem for drawing a Pentagon, prepares the way for drawing any Polygon up to 12, whose sides are equal to 12.1: therefore, in describing the other Polygons, I shall proceed as being thus far advanced.

PROB.

PROB. VIII. FIG. 19.

To describe a Hexagon, whose sides shall be equal to any given length.

Operation.—Take 12.1, the supposed dimension of the side of the Hexagon, and with this radius draw a circle, whose center is at the intersection of the two arches 12.1, 1.1, then will the radius turn six times on the circumference of that circle, as the small dashes which are on it specify. It may be made a general rule without exception, that whatever the diameter of a circle be, its radius will always divide the circumference into six.

PROB. IX. FIG. 19.

To describe a Heptagon, whose sides shall be equal to any given length.

Operation.—Take one of the parts on the arch 12.1, and sweep it to 7 on the perpendicular line. Extend the compasses from this point 7 to 12, which will be the radius of a circle that will contain the given side 12.1 seven times, which forms a Heptagon.

If an Octagon be wanted whose sides are equal to 12.1, take
from

from the center two parts, and sweep the arch 2.8. Lastly, extend the compasses from 8 to 12, which, as before, will be the semi-diameter of a circle that will contain the given side 12.1 eight times, by which an Octagon may be formed.

In the same manner proceed with the other to a circle that will contain the given side twelve times, as the largest circle in the figure evidently does, as marked by the figures 1, 2, 3, &c.

In the preceding directions for drawing the Polygons, their sides are previously determined as to their length, but the circle that will contain the sides so many times, is required to be found. We shall now change the order, and propose a given circle, in which shall be inscribed any Polygon of the above kinds.

PROB. X. FIG. 21.

Therefore a circle being given, let it be required to find the side of a Pentagon that may be inscribed within the given circle.

Operation.—Let the line 9.5 be the diameter of the given circle.

Bisect the diameter, and draw a line at right angles with it; then with the radius 5.9 describe the circle.

H

Second,

Second, Divide any of the quadrants of this circle into five equal parts, and a chord line extended to four of these parts will be the side of a Pentagon that may be inscribed in the given circle, as the figure plainly shews.

PROB. XI. FIG. 21.

To find the side of a Heptagon that will inscribe within a given circle.

Operation.—Let Fig. 21 be the given circle as before. Divide any of the quadrants into seven, as the under right hand one in the figure.

Take then four of these divisions in your compasses, and the whole circle 21 will contain it seven times, which forms a Heptagon.

In this way proceed with the other Polygons, always observing, that whatever number of sides the Polygon is required to have, the quadrant of the given circle must be divided into the same number of equal parts, and four of these equal parts must always be taken for the side of the Polygon without exception. This is exemplified on each quadrant of the circle, which has already been referred to, and, by a little inspection and reflection, cannot fail to be understood.

The

The simplicity of this method of inscribing Polygons in any circle, makes it highly useful to all who are any way concerned with describing such figures on an extensive scale. For instance, how easy is it to lay down the plan of any room, or mark out the foundation wall for any building of these figures, by first drawing a circle equal to their respective areas, and dividing the quadrant of that circle into the same number of equal parts as the room or building has sides; and then taking four of those parts for each side of the building or room.

From these hints the Cabinet-maker also will easily apply this method to any table-top, or other piece of work that is required to be made of these figures.

Of the various Methods of describing Ovals.

PROB. XII. FIG. 22.

To draw an Ellipsis by the intersection of two circles.

Operation.—Let the line B A be the transverse, or long diameter, which divide into three equal parts. Take one of these parts for the radii of the two circles, and on the centers *d* and *s* describe the circles intersecting each other at *nn*. Draw from

n a right line through *d* to *b*. From *n* draw *ns* to *e*, and *fo* of the other side. Place the compass foot on *n*, and extending the other to *b*, sweep the arch *be*. Lastly, fix the foot of the compasses on the other *n*, and sweeping the opposite arch, the oval will be completed.

PROB. XIII. FIG. 23.

To draw an Oval whose transverse diameter shall be equal to the diameters of two given circles.

Operation.—Draw *CD* equal to two diameters of a given circle. Sweep the circumferences of the two circles. Then from the center of each circle, with the compasses in the same position as when the circles were drawn, sweep two arches, *sdp* and *pso*, intersecting in the points *s* and *p*.*

To complete the Ellipsis, fix your compass foot on *s*, and extend the other to *n*; sweep the arch *nr*. Lastly, fix the compass foot on *p*, and sweep the opposite arch, and the work is done.

* It is evident that the angles *sdpso* form a rhomb composed of two equilateral triangles *dsa*, *pdo*, which method of drawing a rhomb of that degree of inclination is most quick and certain. The same observation might have been made on the first oval, but this being more distinct, I chose to mention it here.

The method of drawing these two kinds of Ovals supposes that we are only confined to the length of the long diameters, without regard to the short one; but the following Problem is to draw an Oval of any length and breadth as may be required.

PROB. XIV. FIG. 24.

To describe an Ellipsis whose transverse and conjugate diameters are pre-determined.

Operation.—Let EF be the transverse, and ao half the conjugate. Take ao half of the short diameter, and place it on Ea . Divide then the remaining part of half the long diameter into three equal parts, as the figure shews, and take one of these three parts and lay it on the other way, as from a to n . Take the distance from n to o , and lay it from o to g . Extend then the foot of the compasses from g to n , by which sweep two arches each way, intersecting each other at po . From o to n draw a right line out at pleasure. Do the same from o to g , and also from p to n and g on the opposite side; then will every center be found for each respective arch. From the center n extend the compass foot to E , and sweep the arch Eb . Do the same from g , and sweep the arch mf . Lastly, from o extend the compasses to b , and sweep the arch $b m$; and so of the other side, which will complete the Ellipsis as required.

PROB.

PROB. XV. FIG. 26.

To draw an Oval of any length and breadth by means of two bradauls and a chalk line.

The above methods for drawing ovals suit well for small ovals described on paper, or any kind of metallic surface, when very small ovals are wanted to be drawn on wood. But when ovals of a large size are wanted, they become inconvenient on account of their centers. Therefore Cabinet-makers generally make use of a tramel, by which any oval from two to about four feet may be drawn, both with more dispatch and accuracy than can be done by any other method. The method, however, which is here proposed, is not without its advantages, since by it an oval may be drawn as large as we please, both with little trouble and considerable exactness, provided that materials sufficiently strong and large enough were substituted in place of the bradauls and chalk line.

Operation.—Let BD be the length of the oval, and As half the short diameter. Take then half of the longest diameter, and place it from A to a till it touch the line as exactly at a . Again, take the length as and place it on the right hand at the bradawl; then will the two centers be found in which the bradauls are to be fixed. Lastly, take a line and put it about the

the

the two bradauls, and bring the ends of the line exactly to A, at which point fix your pencil or piece of thin chalk, and begin to describe in the manner that the hand exhibits, and the pencil, &c. will pass through the points D B A as required.

I have found the preceding method vastly convenient in marking out the circular ends of a set of dining-tables; in which case there is always an opportunity of sticking in the bradauls at one side of the board, after a line has been struck to make the edge of the board straight. Then, after drawing a perpendicular line by a square and pencil from half the length of your dining-table top, proceed as above, and you may draw the semi-ellipsis just to suit the breadth of the board, if it is so required.

PROB. XVI. FIG. 27.

To describe an Oval by Ordinate Lines.

Where an Oval is wanted to be described on a smooth surface that will not admit of any incision or rough mark, the following method may be recommended.

Operation.—Draw the inscribed circle in Fig. 27 on a separate board or paper, that the compass foot may not mark the smooth surface. Divide one semi-diameter of this circle into

any convenient number of equal parts. From these divisions (suppose four) raise perpendicular lines to the Periphery* or circumference, which are called the Ordinates of that circle. Observe, the diameter of this circle is always equal to the conjugate diameter of the oval.—Proceed now to draw a line on the supposed smooth surface, on which to determine the length of the long diameter; which divide into the same number of equal parts from the center each way as the semi-diameter of the circle is divided into. From these divisions draw lines across, as the figure shews. Number the ordinates of the circle, as 1, 2, 3, 4, and do the same to those of the intended oval. Take then the compasses, and fixing one foot in 1 on the circle, extend the other to the point where that line touches the circumference. Transfer this opening of the compasses to the lines 1.1 for the oval, and make a pencil mark at the point each way from the diameter. Take the ordinate 2 from the circle, and place it each way from the diameter on the ordinates 2.2 for the oval, and mark the points with a pencil as before. In this way proceed till all the ordinate lines are taken from the circle and transferred to their corresponding ordinates for the oval; after which nothing will remain but to draw a smooth curved line through each point, and the oval will be complete.

* Periphery, from *περι*, *peri*, about, and *φέρω*, *phero*, I bear or carry; which derivation, if I am not mistaken, alludes to the hand bearing the radius about its center, in order to describe the circumference of the circle.

PROB. XVII. FIG. 28.

To draw an Oval by means of a notched piece of wood and a square.

I propose this method as a good make-shift, where a proper trammel is not to be had, and when, perhaps, the method of drawing ovals by the foregoing rules may have escaped the memory, and no book near at hand to assist it.

Operation.—Let $f i$ be the long diameter, and take any square, by means of which draw the line $e t$ at right angles, or square with it. Then notch out a piece of thin deal, as $a g$, to suit the thickness of the square, so that the bottom of g may rest on the surface of the oval, and not prevent a from passing in the circumference $f e$. From the pencil point near a to the end near g must be equal to half the long diameter $g f$, and from the notched part a to the pencil point a must be equal to half the short diameter $e g$. Lastly, place your square, and with one hand keeping it unmoved on the two diameters, by the other sweep the elliptic arch $e f$ for one quarter. How to proceed to the other quarters must be evident to every one, and therefore it is unnecessary to say more.

The truth of this method will appear to every one by
I observing.

observing, that if b , which is the end of the notched wood or trammel stick, is moved gradually to g , the internal angle of the square, then will the pencil point be at f , because from b to the pencil point is equal to fg , half the long diameter: and again, if a , at the notch, be gradually turned to g , the inner angle of the square, then will the pencil point be at e , because from a to e is equal to ge , half the short diameter.

I have already shewn the method of drawing an oval by the sector in Section II. page 38, and therefore I need not say any thing on it here.

PROB. XVIII. FIG. 30.

To find the center and two diameters of any Oval whose circumference is already given, and whose center and diameters are erased or rubbed out.

Operation.—Let $m i q g$ be the circumference of the oval.

Draw the right line $o q$ at random, and draw $m n$ any where parallel to $o q$, by means of two arches, as the figure shews.

Second, Bisect the line $m n$ from its intersection with the circumference of the oval, as at s . Also bisect $o q$ in the same manner

manner as at s . Draw the line ig through ss , and from where ig cuts the oval, bisect ig , as at the center s .

Third, On the center s describe any circle large enough to intersect the circumference of the oval, as at the points cb . Draw the line cb , and bisect it, as at u ; then draw the long diameter ab through us , the center; and, lastly, draw ed parallel to cb ; then will ed be the short diameter, ab the long one, and s the center, as required.

This Problem will be found useful in many cases. For instance, when the face of a fire screen is a true oval, and it is required to put the brass springs on it after being covered with paper or silk, &c. in this case it will be very uncertain whether the oval will hang true, if the springs are only put on by guess.

To avoid uncertainty, take a sheet of paper and lay on the face of the screen, drawing a pencil round its circumference, from which proceed to find the diameter as above.

PROB. XIX. FIG. 17.

To find the Center of any segment or complete circle whose circumference is already given.*

Operation.—Let BDA be the segment whose center is required.

quired. Draw the chord lines AD , DB , any how at random. Bisection the chord AD by sweeping two arches from the points A and D , as the figure shews. Do the same to DB . Lastly, draw the right lines ed and ab through the intersections of those arches, and where these two lines meet in a point, as at c , will be the center as required.

It is evident, if c be the true center of the segment BDA , that it will also be the true center of any complete circle of the same radius.

It is likewise farther evident, that if the chord lines AD and DB were considered as two sides of any regular polygon, the same method would have the same effect in finding its center.

The above Problem will be of use to the workman, when it is required of him to fit up a board into the inside of an arch, in order to ascertain its true sweep.

To this end, let the line BA represent a lath laid across the foot of the arch ADB , to find the length of its opening. Then find the middle of this lath, and from the middle of it put up another perpendicular to it, as D , to find the depth of the arch. After having proceeded thus far, take the board to be fitted up, and make one edge of it straight, and draw a

square line across it, on which lay on the depth of the arch, as at the point D. From D draw the chord lines DA and DB, bisecting them as has already been taught, and the true center will be found for the sweep of the arch; which sweep, if it be exactly sawn, will fit the arch ADB, as required.

PROB. XX. FIG. 18.

To find the Diameter of a Cylinder, when its ends cannot be measured, or of a circular building, when no dimensions can be obtained from its inside.

Operation.—Let the circle, Fig. 18, be considered as the circumference of the cylinder, and let bk represent a straight rod, touching the outside of the cylinder. From any of the divisions on the rod bk put another rod across, till it touch the outside of the cylinder in a square direction from the rod bk ; which is easily done, by keeping the cross rod exactly by the side of the square lines which mark out the divisions. So the lines gb and ik , representing the cross rod, are in a square direction from the long rod, and are produced till they touch the cylinder.

After proceeding thus far, take paper, or a drawing-board, as may be required, and draw a right line equal in length to bk ,

as.

as $b m k$, No. 2. From $b m k$ draw $g b$ and $i k$, of the same length and direction, as $g b$ and $i k$ in Fig. 18. Draw then the chord line $g m$ at random, and from the point m draw $m i$, the other chord. Bisect those chords, as the figure shews, and where the right lines meet in a point will be the center of the cylinder; and any right line being drawn through the center s will determine the length of the diameter as required.

Thus it is evident that the diameter, and consequently the circumference of any round building, may be ascertained by this method.

The lath $b k$, in such a case, may be considered ten feet long, and five inches broad, and each of the divisions on it one foot: and proceeding in the manner taught above, the most accurate dimensions of the diameter of any such building will be found.

SECTION V.

On various useful Problems pertaining to the working Part of both the Cabinet-making and Upholstery Branches: as the Methods of mitring Mouldings of different Projections—of drawing large Circles, without the Trouble of extending a Lath to their Centers, to sweep their Circumferences by—of drawing sweep Cornices, and fitting up their Valances to the Cornices—of mitring the raking Mouldings of Pediments—and of the Manner of planning a Room to cut a Carpet by.

PROB. XXI. FIG. 15. Plate II.

THE extreme lines P E and P I being given, let it be required to find any number of mean proportional lines at equal distances from each other,

Operation.—From the points of the extreme line E P to the points I I of the other extreme draw right lines which will meet in O. Then let it be required to find eight mean proportionals, placed at equal distances from each other. Divide the extreme line P E into ten equal parts, which is allowing one part

part for each extreme. Draw the line ig parallel to the line PO , cutting EO in g . Again, draw $b8$ in the same manner, cutting EO in 8 ; and so of all the rest, as $7, 6, 5, 4, 3, 2, 1$. Through each of these points $g, 8, 7, 6, \&c.$ draw lines parallel to PE , as the figure shews; then will the lines $g.g, 8.8,$ and so on, be the mean proportionals as required.

Observe, in whatever proportion the extreme line EP is divided, into the same proportion will the hypotenuse line EO be divided when lines are drawn parallel to the base line PO from the respective divisions on EP . Therefore if Eb be one-fifth part of the line EP , then is $b8$ one-fifth of the base line PO , and $E8$ one-fifth of the hypotenuse EO . Also if Ec be nine-tenths of the line EP , so will a line from 1 to E be nine-tenths of the line EO , and the perpendicular line 1.1 will be one-tenth of the line EP ; so the line 2.2 will be two-tenths of it; and so on proportionally of all the rest.

From this little theory, the following practice may be deduced.

If it be required to make a step-ladder of inclined fides, as they generally are, or any thing of the same nature, it is evident, from what has been said, and from what may be seen in the figure, that the steps may all be cut to their proper lengths, before

before the ladder be put together in any part of it, which of course saves both wood and time.

To cut the steps to their proper length, proceed as follows. Take a piece of deal, two or three feet long, and plane it over, making at the same time one of its edges straight. Then determine how much the ladder is to bevel off from bottom to top. Take the difference, and having drawn a square line from the straight edge of the board, place the beveling difference, suppose six inches, upon this line, which, in the figure, is represented by the line *E P*. Draw a line, as from *E* to *O*, suppose six inches in length. Draw then the center line of each step from the edge of the board, at equal distances, as the line *g.g*, *8.8*, &c. then will the difference of the lengths of these perpendicular lines be equal to the difference of the length of each step; that is, the step *8* will be the space between *i* and *b* shorter than the step *9*, and so on to the last step *1.1*, which will be all the space between *i* and *c* shorter than *9*, as is evident from inspecting the figure.

To find the bevel of the step-ends, divide *E P*, suppose six inches, in the same ratio or proportion as the side of the ladder is divided into. If the side pieces of the ladder be ten feet long, take one foot and place it by the edge of the before-mentioned board. Then divide the bevel of both sides of the step-

ladder, supposed to be six inches, into ten, and take one-half of the tenth of the six inches, and a line to a full foot in length will give the true bevel for all the steps. Lastly, when the steps are all planed, run a gage on the middle of their edges: upon this gage stroke must be placed the different lengths of the steps, and the bevel for their ends must be struck across from their respective extremities.

Thus it will be evident to any thinking workman, that all the steps may be finished for putting together before the sides of the ladder are begun; and how to proceed with these need not be mentioned.

From the above little theory may also be deduced a useful practice in perspective, when vanishing lines exceed the picture; but this must be reserved for the second part of this work, in which I shall treat of that art.

PROB. XXII. FIG. 29. Plate III.

To draw an Elliptic Cornice of any given length or depth, and to fit the valance to it.

Operation.—Let op be the depth of the cornice with its fascia, and make o to half the length of the cornice; draw the quadrant

quadrant $p\ 2$, and divide its chord into nine equal parts, from whence draw lines perpendicular from the base of the quadrant till they cut the circumference. Divide then the half length of the cornice into ten, and draw perpendiculars from each respective division, marked 1, 2, 3, 4, &c. From the divisions or points on the circumference of the quadrant draw lines parallel with the base line to o , till they cut the perpendicular line to which they belong; that is, from 8 on the circle draw a parallel line till it touch the perpendicular 8, and from the rest do the same, which will form so many points on the respective perpendiculars as will be a sufficient guide for an elliptic arch to pass through. Observe, the ninth division is subdivided, by which another point is gained in the quick part of the ellipsis, for the convenience of drawing the sweep more perfectly. The proportion of the hances may be easily ascertained, as the figure shews; but in this particular fancy will generally be the rule.

Method Second.

It has already been observed, that the chord line of the arch $2\ p$ is divided into nine equal parts, from which lines are drawn till they touch the circumference; after which draw the line $p\ 9$, as a correspondent chord for the elliptic curve, and divide it into the same number of equal parts as the chord of the circle is divided into. Then take, for instance, the length of

the perpendicular line 8.8 in the circle, and transfer this to the perpendicular line 8 on the other chord, and mark it with a pencil. Again take 7.7 from the chord of the circle, and transfer it to 7 on the other chord, and mark it as before. In this way proceed till all the perpendicular lines on the chord of the circle are placed on the correspondent perpendiculars on the elliptic chord, and nine points will be obtained through which the curve is to pass as before.

To fit up a Valance to a Cornice of the above Kind.

The stuff for the valance should be tacked straight on a board, and with a piece of soft chalk draw a line answerable to the line 10 o, or bottom of the fascia. Divide the fascia of the cornice in the manner shewn in the figure, and draw square lines up to the cornice: do the same on the stuff for the valance, and take from the cornice the length of each perpendicular line o, 1, 2, 3, &c. &c. and transfer those different lengths to their respective perpendiculars on the stuff, and mark them with chalk. Lastly, by a steady hand draw, with soft chalk, a curve to pass through these points, which, if accurately done, and cut by the line, must evidently fit at the first trial.

PROB. XXIII. FIG. 31. Plate III.

To describe the Arch of a Segment of a large Circle, without the assistance of a lath from its center.

Operation.—Let Fig. 31 be considered a segment, whose chord is twenty feet long, and its swell two feet, as the perpendicular C 10. Draw then a semi-circle, whose radius shall be equal to C 10. Divide one quadrant into ten equal parts, and into the same number divide half the chord A C. From each division on A C raise perpendiculars, as 1, 2, 3, and so on. From 9 on the quadrant draw a line parallel to A C, till it touch the perpendicular 9, and mark it with a point. Again, from 8 on the quadrant draw a parallel till it touch the perpendicular 8, and mark it as before; and so on, from 7 to 7, 6 to 6, till the whole are done. Through the points on the several perpendiculars draw, with a steady hand, a curve line passing through these points, and it will form a regular arch.

Method Second. (On the right hand of Fig. 31.)

Operation.—Draw the chord of the quadrant, and divide the same chord into ten equal parts, and raise from these equal divisions lines perpendicular to the chord, till they touch the quadrant

quadrant arch. Divide the line CB into ten equal parts also, and from 10 perpendicular to C , draw the line 10 B . On the chord of the quadrant take your compasses, and fixing one foot on the perpendicular 9, extend the other foot to the point where the same perpendicular touches the arch. Transfer this to the other 9, and make a pencil mark. Again, place one foot of the compasses on 8 of the chord of the quadrant, and extend the other foot to the point where the perpendicular cuts the arch. Transfer this also to the other 8, on the line 10 B ; and in this way proceed for all the rest, drawing a curve line through the respective points thus found, which will form a regular arch as before.

PROB. XXIV. Plate IV.

To take the Plan of a Room in an accurate manner, so that a Carpet may be properly cut by it.

Operation.—The room being cleared of every obstruction, and the floor swept clean, proceed as follows:

First, Take a chalk line, and by it strike a line parallel to that side of the room which seems freest from irregularities, as $d\ c$, in Plate IV. Then by Problem III. page 23, raise a perpendicular from c continued to b . Proceed next to the other end of the room, as at d , and by the second method of Problem

blem III. if most convenient, raise another perpendicular continued to a . Draw then a line from a to b , exactly parallel to $d c$, the opposite side of the room. Then will the angles $a b c d$ form a true Parallelogram, proportioned to the size of the room, by which the principal distortions or irregularities of any of the sides of the room will at once appear. For instance, the angle v is somewhat out, as the line parallel to $a d$ plainly shews: and in this manner any other angle of the room, whether obtuse or acute, may be ascertained.

Second, Let the hexagon end of the room be next considered; and let it be observed, that the plan-taker is supposed to have no square, or straight rule, but only a case of instruments and line. Therefore, in order to know how much the side $i l$ bevels off from a square, take the line and strike it by the side $i l$ of the hexagon, and continue the line at pleasure beyond b . Take then the brass protractor, and place the center of its base to i , as the figure shews. Make a pencil mark over 90, on the arch of the instrument, and from i draw a straight line across the pencil mark to g at pleasure. Take the side $i l$ of the hexagon, and place it from i to b . Draw $g b$ parallel to the base of the protractor, or to $b c$; then will $g b$ shew how much $i l$ is out of square, as required. Examine then the other side of the hexagon by the same rule, and if there be any variation from the opposite side, it will easily be discovered by the same rule.

Proceed

Proceed to the windows, and find the rake of the jambs in the same manner as before, which needs not be repeated: only observe, that the protractor cannot be placed to the architraves because of their irregularity; and therefore it must be placed on the line *ab*, as the figure itself expresses.

Lastly, Proceed to the circular end of the room, with its windows; and in order to find the center of the arch *rop*, draw *pv* at its foot, and parallel with *ad*. On the middle of *pv* raise a perpendicular, and continue it to *t* at pleasure. Draw then the chord *op*, and bisect it, whence raise a perpendicular, cutting *ot* in *t*, which will be the center. From the opening of each window draw the several radii, as shewn in the figure, by which it will be easily seen how much the jambs vary from these central lines.

The room being thus lined out, take a sheet of paper, and lay down a scale of feet and inches that will comprehend the longest part of the room. Measure then with your common rule the sides and ends of the Parallelogram which was chalked out on the floor, and whatever these measure by the rule, take the same number of feet, inches, and parts from the scale, and draw the Parallelogram on the paper in the same manner as was done on the floor: and in this way go on, taking off every dimension from the floor by the rule, and transferring them
to

to the paper by the scale; so that at length the paper will have all the lines and shapes which the room has, by which means it is evident that the most exact measurement will be obtained.

The next thing to be done is to provide a place large enough to lay down the full size of the room again. The order will now be reversed at home; for those measurements which were before taken from the room by a rule, and transferred by the scale on the paper, must again be taken from the paper by the same scale, and replaced on some convenient place, by the same rule that was used in taking the plan. If this method be pursued with accuracy, I am certain it cannot fail to answer the purpose, if a proper allowance be made for straining the carpet.

PROB. XXV. FIG. 32. Plate V.

To mitre any thing of the nature of a Comb Tray, the breadth of whose sides shall be given, and their inclination from a perpendicular predetermined.

Let ba be considered equal to the given projection of the side of the tray, and let the perpendicular ea be the height of the spring of its sides. Draw the bevel line eb , and fixing one foot

of the compasses at *b*, sweep the arch *e d*; then will *d* on the base line be the mitre point of the side of the tray *g l*, and *d b* will be the required breadth of its sides, necessary to raise it to *e*, perpendicular over *a*, the point of projection. Again, if the tray side should be required to be raised from its base up to *m*, then draw *m b*, which will be the breadth of the side, and with *b m* in your compasses, sweep the arch *m n*; then will *n* be the mitre point of the side of the tray, as required. How much shorter the point *n* is than a full mitre, is seen from *n* to *o*, of the dotted lines meeting together.

Whence it is evident, that as the tray sides are raised higher and still higher from their base, the mitres will become proportionably shorter, till at length the sides will be in an upright position, and consequently must stand in a perpendicular direction from their base or bottom. On the other hand, if the sides of the tray be depressed nearer to their base, and still nearer, their mitres will proportionably increase, until they arrive at full length, and consequently they will be in a perfect horizontal position, or parallel to their base.

A little reflection will easily convince the reader, especially the Cabinet-maker, of the propriety and usefulness of these remarks. How the edges of the sides of the tray are to be bevelled to suit their rake, must be evident by inspecting the figure,

figure, and is generally known by all workmen, and therefore it is unnecessary to dwell further upon it.

PROB. XXVI. FIG. 33. Plate V.

To find the Lines for working the Mouldings of a Clock Bracket, &c. when the front moulding projects more than the ends.

Operation.—Let $a o b d$ be the plan of the clock bracket. From the center of $a o$ draw the mitre lines to b and d , and from the center let fall a perpendicular, as at f . From this perpendicular draw a profile of the cavetto and astragal, according to the projection intended for the ends of the bracket. From the spring of the cavetto on the top of the necking raise a perpendicular up to the line $a o$; then from the upper part of the cavetto, as from 1, raise another perpendicular up to 1 on $a o$. From where these perpendiculars intersect with the mitre line, divide the intermediate space into any number of equal parts, as at 1, 2, 3, 4. From these numbers on the mitre line draw perpendiculars up to the correspondent figures on $a o$, and continue them downwards till they touch the cavetto at 2, 3, 4. Lastly, draw from the utmost projection of the astragal or necking, a perpendicular, cutting the mitre line at 5; then from 5, 4, 3, 2, 1 on the cavetto draw parallels out at

pleasure. Take in your compasses $d o$ from the plan of the bracket, and place it from d to p , No. 1. From p let fall a perpendicular; then from the plan, as before, take 1.1 and place it from 1 on the perpendicular line p to 1 on the parallel line. Again, take the line 2.2 from the plan, and place it on the parallel line 2 to 2, and so of all the rest, forming so many points, by which a profile of the front cavetto may be formed, and which will mitre in with the end cavetto, if the mouldings are exactly worked to these profiles, and the mitres be accurately cut. How the mitres are to be cut is easily seen by the mitre lines on the plan.

In Plate II. Fig. 12, an example of the same kind is shewn, as it may be performed by the Sector.

Let the quadrant $A D$ be considered as one of the cavettoes to be mitred together. Then let it be proposed that another cavetto is to mitre to the former, whose projection shall be equal to 1.10. Proceed then to draw this cavetto by the same directions as are given in page 39 for drawing an Oval; after which the cavettoes are to be worked according to these curves. The length of the mitre for the least projecting cavetto is from 90 to 10, and that of the largest projecting cavetto is from 10 to A , and the mitre line is 9.10.

By these methods it is evident, that any moulding of different projections, and consisting of various members, may be worked, and cut so as to mitre exactly together.

PROB. XXVII. FIG. 34. Plate V.

Of working and mitring raking Mouldings.

Let No. 1, Fig. 34, be a level ovolo in a broken pediment. Make its projection equal to its height. Divide the height of the ovolo into any number of equal parts, and from these divisions draw parallel lines, as is shewn in the figure. Next, from the extreme points of the ovolo draw two parallel lines, according to the rake of the pediment described below, which will of course increase the height of the ovolo. Draw then a perpendicular or square line from either of the raking lines, as at No. 2. Divide this square line into the same number of equal parts, and from these divisions draw lines parallel to the raking part. Take then 5.5 from No. 1, and transfer this opening of the compasses to 5.5 on No. 2, and make a pencil mark where it extends to. Again, take in your compasses 4.4, from No. 1, and transfer this also to 4.4 on No. 2, and mark it as before; proceeding in the same manner with the rest; by which points will be found to enable us to draw the raking ovolo so that it will mitre with the level one at No. 1. Lastly, if a pediment

be

be open, then it will require returning mouldings to mitre in with the raking mouldings in front; for which returning members there must be another drawing made, as No. 3. The fillets, &c. of these returning mouldings ought to hang perpendicular with the level cornice; therefore draw, at No. 3, a line perpendicular with the level cornice. Raise then another perpendicular at a distance from that which was first drawn, equal to the projection of the level ovolo, as is shewn by the dotted line in No. 3 of Fig. 35; and from the point where this perpendicular cuts the raking line, draw a line parallel with the level cornice, which gives the whole breadth of the returning moulding, as is apparent by inspection.

Divide the whole breadth of the returning ovolo into the same number of equal parts as before, and proceed exactly in the same manner to find the curvature of the returning ovolo as was done to find that of the raking one, and the whole by these methods may be completed.

In the same manner may be found the raking and returning cyma-recta mouldings, described in Fig. 35, which it is unnecessary to say any thing about, after what has been said on the ovolo.

PROB. XXVIII. FIG. 36. Plate V.

As I have in this Section described the methods of drawing and mitring mouldings of different projections, and also of drawing and mitring raking with level mouldings, it may be proper here to describe the proportion of the Tuscan raking Pediment, and the manner of drawing it.

It is true, according to an orderly arrangement, the Pediment should come after the column; but this is of small consequence, if it can as well be understood in this place.

The intention of a close pediment, whether raking or circular, is not only to ornament the front door or entrance of any building, but likewise to shelter such as seek admittance from inclement weather. For this purpose the raking close pediment of any order is best calculated; for whilst we are sheltered from rain or snow by the bold projections of the several members of each order, especially the Doric, the descending showers easily and quickly glide off on each side, on account of the rake of such pediments.

It is therefore improper to have open pediments of any order at the exterior entrances of buildings: and it is considered

sidered by architects as improper to have close ones over interior entrances or door ways, where they are only employed as ornamental.

The pitch of the Tuscan pediment is the same with the other orders, for in this respect they are all uniformly the same; but their intercolumniations, or spaces between the pillars or pilasters, together with other particulars, vary according to the respective order to which they belong; which I shall mention afterwards, in treating on the Orders.

To proportion and draw the Tuscan order, proceed thus:

Observe, that Fig. 36 is exactly half the pediment only; and therefore, in drawing a whole pediment, the divisions specified in the figure must be laid on each way from the central line. And observe likewise, that the frieze and architrave are not drawn to the cornice, because they are not wanted in describing the pediment.

Operation.—Lay down three diameters from the center of the pediment to the center of the shaft, as at 1, 2, 3, in the figure. Divide a diameter into eight equal parts, and take three of these and place them each way from the center line of the shaft, which gives the upper diameter of the column, as
the

the figure shews. Again, divide a diameter into four, as that distinguished by the writing in the figure, and take three of those parts for the perpendicular height of the cornice: at this height draw a parallel line at pleasure sufficient for the whole length of the pediment, as the upper line with the numbers. Then take the perpendicular height of the cornice, and place it from the outside line of the shaft on the line continued out from the under edge of the cornice, which will determine its projection, as is easily seen by the level scale line *b*. Raise a perpendicular line from the whole projection, as *g*, till it cut the upper parallel line; then will this line serve as a scale for the heights of each member in the cornice, the proportions of which are easily seen by the aliquot parts on the scales; but if not rightly understood, the reader may suspend his judgment till the Tuscan order is described.

Divide the upper parallel line, which is equal to one-half of the whole length, into nine equal parts, and give four of these for the pitch of the pediment, as the figures 1, 2, 3, 4, shew. Draw then a right line from 4 to the utmost projection of the level cornice, and proceed to draw each member of the level cornice, as the scale lines direct.

Note, The two upper lines, containing the nine divisions, represent the upper fillet of the level cyma-recta.

The next thing to be done, is to proportion the members of the raking cornice by those of the level one. To do this, draw a square line from the pitch of the pediment, and continue it till it pass through the level cornice. Take then the skew measurement of the lower fillet of the level cyma-recta, as *a b*, and transfer this to the raking cyma-recta downwards, from *a* to *b*. Again, take *b c* from the level corona, and transfer it from *b* to *c* for the raking corona. Lastly, take *c d, e f* in the same manner, and transfer them one after another for the raking mouldings, as before; after which, draw lines through the several points parallel to the pitch or raking line, and the pediment will be completed for shading if required.

SECTION VI.

*Of the Names and Properties of various Geometrical Solids—
Of finding curved Lines to answer the Sections of various
irregular Figures—and of the Nature and Construction of Hip
and Elliptic Domes.*

IN Section III. page 43, I have there observed on useful geometrical superficies, that to have some knowledge of their names and properties is certainly of advantage to every one, especially to those who are concerned with drawing or making pieces of work of the like figures.

With equal propriety the same may be affirmed of the useful geometrical solids, the knowledge of whose names and properties frequently enable us to communicate our ideas of the figures of various objects that occur to us, with greater precision and freedom than we otherwise should be able to do, were we, for want of this knowledge, obliged to use a number of explanatory words and signs before we could be understood.

However, I have not introduced more of these than what I think quite necessary to be known, and which I shall now endeavour to explain in as short and clear a manner as I am able.

Of the Names and Properties of the General Solids.

In Plate VI. No. 1 is termed a Cube, which is a regular solid, bounded by six equal geometrical squares or surfaces, from *Κυβος*, *kubos*, a dye. It is also called by some a Hexaedron*, because it has six seats or bases on which it is capable of being rested.

No. 2, is a Parallelopipedon, or Parallelopiped, a regular solid, contained under six parallelograms, whose opposite sides are parallel and equal; or it is by some called a Prism, whose base is a parallelogram.

If a piece of wood be seven or eight inches long, three broad, and two and a half in thickness, so planed that its sides are all parallel, and cut so that its ends are square to its sides, then will the piece of wood be of the figure of a Parallelopiped.

* Hexaedron, from *ἕξ*, *hex*, six, and *ἑδρα*, *hedra*, a seat.

No. 3, is a Pentangular Prism *, so called because its ends are bounded by pentagons, or five-sided surfaces, and its sides by five parallelograms.

There are various kinds of Prisms; as No. 4, is an Hexangular; No. 5, a Trapezoidical; and No. 6, a Triangular Prism.

An Hexangular Prism is terminated at its ends by two six-sided surfaces, and its sides by six parallelograms.

If a piece of wood, seven or eight inches long, be rounded to two or three inches diameter, and if this piece of round wood be planed so as to have six sides parallel to each other, then it will be of the figure of an Hexangular Prism.

Again, a Trapezoidical Prism is one which is bounded at its ends by two Trapezoids, (see No. 5, Plate II.) and whose sides are four parallelograms, two of which are equal to each other, but not parallel, and two unequal in width, yet parallel.

If a piece of wood be seven or eight inches long, as before, and if one of its sides be about three inches broad, and two of them two inches and a half, inclining or beveling off alike

* Prism, from *πρισμα*, "something sawn or cut off."

from the side which is three inches, reducing the fourth side to two inches broad, then will the piece of wood be of the figure of a Trapezoidical Prism.

Lastly, the Triangular Prism is so called, because its ends are bounded by triangles, or three-sided superficies, and its sides by three parallelograms.

If, as before, a piece of wood be planed so as to have three sides, suppose each two inches broad, and their angles parallel, it will then be of the figure of a Triangular Prism.

No. 8, is a Tetrahedron*, called so because it comprehends, and is bounded by four equilateral† triangles. It may also be conceived as a triangular pyramid of four equal faces.

Hence, if a piece of wood be first cut into the form of an equilateral triangular prism, and then be terminated from its base till the three sides meet in a point perpendicular to the center of the base, and if the terminated or inclined sides be equal in length to their base, then will the wood exhibit the figure of the geometrical solid, termed a Tetrahedron.

* Tetrahedron, from *τετρα*, *tetra*, four, and *εδρα*, as before.

† See Plate II.

No. 7, is an Octahedron. It receives its name from the eight equal and equilateral triangles by which it is bounded. It may also be conceived as two quadrangular pyramids, joined together at their bases.

If, therefore, a piece of wood be formed into an equal quadrangular prism, and if this prism be terminated from its center each way, till all the sides come to a point perpendicular to the centers of the respective bases of the pyramids supposed to be joined together, then will the piece of wood, thus cut, give the true figure of an Octahedron.

No. 15, is a Dodecahedron, a regular solid, bounded by twelve pentagons.

To form or construct this regular solid, a piece of wood may first be turned round, and then planed into ten equal sides. Draw then a regular pentagon (Plate II. Fig. 19) on each end of the piece of wood, one of whose sides shall be equal to one of the sides which the wood was first planed to. Lastly, make five faces on each end of the wood, which shall comprehend two of the first-mentioned ten sides, and one of the sides of the regular pentagon drawn on each end; then will the piece of wood form the figure of a Dodecahedron, as required.

No. 16, is an Icosahedron, which is a regular solid, composed of twenty equilateral triangles. See Plate II. Fig. 7.

This figure may be considered as consisting of twenty triangular pyramids, as No. 8, whose vertexes meet in the center of a sphere, imagined to circumscribe it, and therefore must all have their heights and bases equal.

To construct this solid, a piece of wood should first be made round, and then planed into six equal sides. Upon each side draw an equilateral triangle, and the spaces between each triangle must be cut away to the side of the triangle thus drawn, and when this is done, there will then be four more planes or faces for four more equilateral triangles, which will make ten. Find the center of one end of the piece of wood, and terminate each side of the hexagon to this center, and there will be produced six more equilateral triangles, which added to the other, make sixteen. Find the center of the other end, and terminate the before-mentioned four sides to this center, and other four equilateral triangles will be produced, which will complete the twenty as required.

From what has been said, it is evident that five of these solids are regular, since they may each of them be inscribed within a sphere, so that each angle shall touch the circumscribing

scribing sphere in some point. Hence, to form these regular solids, namely, the Cube, Octahedron, Tetrahedron, Dodecahedron, and the Icosahedron, it is presupposed in the above constructions, that the pieces of wood mentioned are all cubes, whose sides are equal to the dimension of each figure.

No. 13, is a Pyramid, a solid, whose sides rise from a geometrical square as its base, and terminate in a vertical point.

As the height of this solid is at pleasure, its sides are sometimes bounded by equilateral triangles, and sometimes by isosceles, as the figure referred to.

Nor are we to confine our ideas of Pyramids to such only as have square bases, for these may be either triangular or polygonal, while yet their respective sides shall terminate in a point perpendicular to the center of their bases.

The learned are divided in their opinions about the derivation of the term Pyramid: some think the name is from *πυρ*, *pur*, fire, because Pyramids ascend to a point like fire; but others more confidently affirm, that it is from *πυρος*, wheat, or corn. "Not," says the author of this last opinion, "that we are to suppose that the Pyramids were ever intended for granaries; but that the Greeks, when, after many generations,

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they visited Egypt, and saw those amazing structures, looked on them as store-houses for grain; and knowing Egypt to be a country fruitful in corn, they called them Pyramids—corn store buildings; being, as they thought, the repositories for all the produce of Egypt.”

No. 9, is a Cylinder. This is a solid, bounded by two equal circles at its ends, and a parallelogram revolving round their circumference. This figure is fitly represented by a garden roller, whence its name *κυλινδρος*, *kulendros*, a roller; and as for its construction, it is so simple that it is unnecessary to say any thing about it.

No. 12, is a Cone; a solid, bounded by two superficieses, one of which is convex, and the other straight.

The base of a Cone is sometimes an ellipsis, and sometimes a circle terminating to a point perpendicular to its center. From this center to its vertical point, a line is supposed to pass, called its axis, on which this body might be made to revolve. And the same may be observed of the Cylinder, Conoid, and Sphere, each of which has its imaginary axis, or right line, passing through its center, about which they may be made to turn.

No. 14, is a Conoid; a solid, which terminates from its base to its vertical point in a curved or elliptic direction. Sometimes the curve of its side is hyperbolic, and sometimes parabolic. See Plate II. Fig. 35, 36.

Its base, like the Cone, is either an ellipsis or circle.

No. 10, is a Hemisphere*, which is one-half of a globe cut by a plane passing through its center, and therefore is contained under two superficies.

No. 11, is a Sphere, or whole globe, which is a body or solid, bounded by one convex surface, whose parts are all at the same distance from the central point, as the periphery of a circle is to its center.

Of the Sections and Coverings of regular and irregular Figures; and how to find curved Lines to answer their various Sections.

The Section † of any solid is, when it is supposed to be cut by any plane passing in some direction through it, which,

* Hemisphere, from *σφαῖρα*, *sphaîra*, a globe or sphere, and *ἡμισυς*, *hemisus*, half, i. e. half a globe.

† Section, a cutting or dividing; “from *seco*, to cut.”

of course produces a surface or superficies consonant to the nature of the section, and agreeable to the shape of the solid which is cut.

Hence, if a cylinder be cut oblique to its base, this section will produce a surface perfectly elliptic; and if a cone, Fig. 12, Plate VI. have a section parallel to its axis, the curved boundaries of the superficies will be hyperbolic. See page 52.

“ If a sphere be cut in any manner, the plane of the section will be a circle, whose center is in the diameter of the sphere.”

But if two plains, or straight surfaces, cut each other, their common section is a right line.

I mention these particulars, that the reader may more readily and clearly understand the following Problems.

PROB. XXIX. FIG. 32. Plate VI.

Let Fig. 32, Plate VI. be considered a solid, of the shape of a vase, whose covering and section are to be found; or, in other words, if a vase is required to be veneered, how to cut the veneer so as each joint shall appear straight when the veneer is laid.

Operation.

Operation.—Draw the shape of the vase, which, in this case, is a semi-ellipsis on the conjugate diameter. Draw a perpendicular line through the center of the vase, which will be the long diameter. Divide this diameter into a number of equal parts, and on these divisions draw lines parallel to the conjugate diameter, as the figure shews at 1, 2, 3, 4, &c. Draw then on each of these right lines a semicircle, and, for the sake of greater accuracy, let the eighth space be subdivided, by which another circle will be obtained near the center, as at 9. Draw next a perpendicular line at pleasure, as at No. 1. Proceed then to take the dimensions of the curvature of the vase thus: Place one foot of the compasses on 10, and extend the other to 9, and with the same opening of the compass fix one foot on 10, in No. 1, and sweep the arch 9 at pleasure. Again, fix the compass foot on 9, and extend the other to 8 on the vase, which transfer from 9 to 8 at No. 1, and opening the compasses, fix one foot on 10, and with the other sweep the arch 8 at pleasure. In this manner proceed with all the other divisions on the vase, until its whole curvature is laid down on the perpendicular line at No. 1.

After proceeding thus far, it must then be considered how many pieces of veneer will cover the circumference of the vase, and how broad the veneers may be laid; which in this example I have supposed to be fourteen. Divide therefore each semicircle
into

into seven, as specified by the small dots on each arch. Upon the semicircle 9 of the vase, place one foot of the compasses on 9, and extend the other to the perpendicular line, which will be half the breadth of the veneer, according to the number of pieces proposed. Take this opening of the compasses and place it each way from the perpendicular line at No. 1 on the arch 9. Again, on the semicircle 8, take the space from the perpendicular line to 8, and transfer this to the arch 8 at No. 1, placing it each way from the perpendicular as before. In this manner proceed with the rest, by which the proper breadth of the veneer on each semicircle will be determined; and if a regular curve line be drawn through each point on the several arches at No. 1, the curved boundaries of these arches will be the exact shape of the veneers, which, when properly laid down, will then have the appearance of so many straight joints. And hence, by whatever rule or method we find the coverings of solids, regular or irregular, by the same rule we also find curved lines to answer their perpendicular sections; for it is evident, if the vase, after being veneered, was cut through its center perpendicularly, and the veneer raised up again, that its edge would be a faint curve, like that at No. 1.

PROB. XXX. FIG. 33. Plate VI.

To find the covering and perpendicular Section of a Solid partly convex and partly concave.

Operation.—Draw the profile of the solid proposed, as Fig. 33. Let fall a perpendicular from the center of the top. Draw a line from 11 on the profile parallel with the top, and divide the aforesaid perpendicular line into any number of equal parts, which in this example is ten. Draw parallel lines through each of those divisions, and on these lines draw so many semicircles, whose diameters shall be equal to the length of each line. Draw a perpendicular at pleasure, as at No. 1. Fix one foot of the compasses at 1 on the profile, and extend the other to 2. With this opening fix one foot at 1, No. 1, and sweep the arch 2. From 2 on the profile, extend the compasses to 3, and transfer this from 2 to 3 at No. 1. Then opening the compasses, fix one foot at 1, and sweep the arch 3 at No. 1, and so on of all the other; by which the dimensions of the curvature of the profile will be obtained.

Lastly, take half the whole space from 11 on the semicircle to the perpendicular line specified by the dot, and place this opening of the compasses each way from the perpendicular line on the arch 11 at No. 1, and mark the places with a pencil.

Proceed

Proceed to 10 on the semicircle 10, and take half of its whole space, and place it each way from the perpendicular on the arch 10 at No. 1, as was done on the arch 11 before; and in this manner go through the whole, and a sufficient number of points will be found in order to draw an irregular curve answerable to a perpendicular section of the proposed solid, and which will also answer for its covering or veneering.

. But here I must observe to the workman, that in case it should be proposed to him to veneer any thing of the like forms of Fig. 32 and 33, it would not do to cut out the veneers so broad that fourteen pieces would be equal to the circumference. It would require twenty-eight pieces at least, before they could be laid down with safety and ease, especially if it were required that the joints of the veneers should be so close as to preclude the necessity of putting in stringing to hide them. I speak this not merely from theory, but practice, having myself veneered knife-cases of the same shape with the figures in the Plate, and where no stringing was admissible to hide the joints. But every thinking workman will easily perceive that it makes no difference in the methods of finding the curve lines for the covering, whether the number of pieces be fourteen or twenty-eight.

By these methods a sphere or globe may be covered, and a
curve,

curve, answerable to any section, through its center may be found. I have not given any example of this on the Plate, as it is presumed that a few hints will serve, after what has already been said on the subject.

Operation.—Draw a circle whose diameter shall be equal to the axis of the sphere to be covered. Divide the semidiameter into nine equal parts, and on these parts draw lines across at right angles with the diameter, till they touch the circumference of the circle on each side. From these several lines draw semicircles, as was done before in Fig. 32 and 33. Divide the several semicircles into eighteen degrees each, and take one degree from the largest semicircle, and place this opening of the compasses on a right line eighteen times. Then from the extreme points on this line draw arches each way, till they meet in the center of the line. Lastly, transfer half a degree from each semicircle to their correspondent arch, laid on each way from the right line, as was done on No. 1, Fig. 32; and the whole thus transferred, a curve line passing through each half degree laid on the several arches both right and left from the center line, will form the proper covering for the sphere or globe as required.

Observe, the covering will be of the figure of two segments of a circle joined together, and the length of the cover-

ing will be equal to half the circumference of the proposed sphere.

I must here entreat leave to remark, that notwithstanding the above directions are addressed to men in the wooden way, yet it is certain that the Upholsterer may avail himself from what has been said on the subject: for the coverings of the like solids made of any kind of stuff, ought to be cut by the same methods, and sewed together in seams answerable to the joints in wood: but the elasticity or pliability of stuffs, &c. makes it unnecessary to cut them into such small pieces as is absolutely required in wood.

PROB. XXXI. FIG. 34. Plate VI.

To find the Section and Covering of a Knife-case whose front is a double oge.

Draw half the plan of the front, as Fig. 34, and divide the sweep of the front into ten equal parts, as the figure shews. Next determine how much rake the knife-case is to have from back to front, by which it will be easily seen how much the swell of the front falls at that rate, as the diagonal line 10.1 shews in the case before us. Draw from 10 of the diagonal line a perpendicular at pleasure. From the several divisions

divisions on the curve of the front draw parallel lines, till they cut at the numbers on the aforesaid perpendicular. Observe, that the numbers on the perpendicular line are placed to answer the parallel lines as they proceed from each number marked on the curve of the front. Every thing, being now prepared for finding the covering and section of the knife-case, proceed to No. 1, and draw a right line at pleasure, as 1.11. Take from 11 to 10, or any other of the divisions, on the front of the knife-case, and with the compasses repeat it nine times on the right line 1.11 at No. 1. Then observe, that from 2 to 1 on the front of the knife-case is rather a wider space than the other divisions, which are all equal. The intention of this is, to bring the parallel line, which proceeds from 2 on the front, a little farther on from the front line 1.1; therefore take from 2 to 1 on the front, and place it from 2 to 1 on the right line at No. 1, then will the whole length from 1 to 11 at No. 1 be equal to the whole curvature of the front of the knife-case, supposed to be stretched out in a right line. On the several divisions on the right line 1.11, at No. 1, draw perpendicular lines at pleasure. Take in the compass the space 1.1 from Fig. 34, and transfer this opening to the perpendicular line 1 c at No. 1, marking it with a pencil. Then again take the space from 2 to the diagonal line at Fig. 34, and transfer this to the perpendicular line 2 at No. 1, and mark it with a pencil as before. Do the same from the lines 3, 4, 5, 6, 7, at Fig. 34, and

observe that 11 follows 7, because it proceeds from the point 11 on the front of the case; therefore take the space from 11 on the perpendicular line to where the parallel cuts the diagonal, and place it on the perpendicular at No. 1. Likewise take 8 and 10 in the same manner. As for 9, it is lost, because that division on the front of the knife-case falls on the right line, and, of course, has no projection. Lastly, through all the points on each perpendicular at No. 1, draw a curve line, which will answer to the section of the knife-case, if it be cut answerable to the bevel line 10.1 on the plan of the case.

The dark shade *e a b*, at No. 1, shews half the veneer or covering of the knife-case; and if a piece of strong paper be cut double, according to the boundaries of the dark shade, it will serve as a pattern to cut the knife-case open by, and likewise to cut the veneer by, before it is glued down. The inside veneer for the front of the top may also be cut near enough by it, though it will vary a little; but this defect is not equal to the advantage of having the inside veneer pretty nearly cut to the sweep, because it will then glue down much easier, and be less liable to split.

From what has been said on this Problem, the ingenious workman may apply the rules and observations to other purposes that may be of more importance than the cutting and
veneer

veneering of a knife-case, which I must leave him to do as necessity may require.

*Of the Nature and Construction of Hip and Elliptic Domes
for Beds.*

Domes of various kinds have, for many ages past, been introduced into elegant and magnificent buildings, on account of their graceful effect and majestic appearance.

I am of opinion that the notion of employing domes for the roofs of grand buildings, was first suggested by the appearance of the hemisphere surrounding our earth or horizon, forming a canopy or roof to the globe; which if it were so, domes had their origin from a truly sublime and magnificent idea.

The use of domes for the tops of beds is of much later date than for buildings; but it is certain, whoever he was that first employed domes for the tops of beds, he must be considered as a person of enlarged ideas, as no other top or roof for a genteel bed can equal them: therefore we see them generally used for state beds, where, it is certain, both grandeur and bold effect are essentially requisite.

The term Dome generally implies a vaulted, arched, or spherical roof. Some derive it from *domus*, a house, and others from the barbarous Latin *doma*, a roof or open porch.

When an arched roof is raised from a square or oblong plan, it is called an Hip Dome, because they require mitre ribs at each angle, uniting in a center at top. But those domes which take their rise from an oval plan are called Elliptic; and, lastly, those which have an octagon or hexagon for their plan may be styled Polygonal Domes.

PROB. XXXII. FIG. 35. Plate VII.

To construct an Hip Dome.

Operation.—Let *ABCD* be the under tester, upon which another tester is to be fixed to receive the ribs of the dome. Draw the diagonals *DB* and *AC*, and their intersection will be the center for the dome. Draw a right line through the center parallel to *AB*; draw another line through the center at right angles with it, then will the diagonal lines be the plans of the hip ribs, and those at right angles to each other will be the plans for the center ribs. Draw a circle from the center of the dome of about eight inches radius, as the figure shews, which is intended as a ground for ornament in the center of the

the dome at the inside, and also to combine together the hip and center ribs.

Proceed next to consider the height of the dome as may be required. Let 7.6 at No. 1 be the perpendicular height of it, and let $m n$ be the width of the dome. Then draw a semi-ellipsis to pass through the points m 6 n . Divide half of this semi-ellipsis into as many equal parts as it may be thought necessary to have ribs in that space, which in this example is six. Draw on these divisions perpendicular lines, as the figure shews, and subdivide the last space, from which raise a perpendicular as before.

Proceed to No. 2, and divide half the length of the dome, as $f o$, into the same number of equal parts as half the width was divided into. From the divisions raise perpendiculars at pleasure. Take the length of the several perpendiculars from No. 1, and place them on the corresponding perpendiculars at No. 2, and draw a curve line through each point; then will the ellipsis thus produced be the outside shape of all the long ribs, the same as No. 1 is of the short ribs. Lastly, proceed to No. 3, which is for the four hip ribs. Draw the dotted lines from 8, 9, 10, 11, 12 at No. 1 till they cut the diagonal line $g b$ at the corresponding numbers. From these intersections raise perpendiculars at pleasure, as before. Transfer the length of each

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perpen-

perpendicular line from either No. 1 or 2 to No. 3 on each perpendicular as numbered, and drawing a curve line through each point as before, it will produce an ellipsis for the outside shape of each hip rib.

The next thing to be considered, is the length required for each rib, according to their distance from each angle of the dome. A little thought will make this easily understood; for if No. 3 was placed in an upright position, being considered as a frame, and if the portion of the curve from *n* to 1 at No. 1 was placed upright to it, the two points 1 in No. 1, and 1 in No. 3, would coincide, and the point 2 of No. 1 would coincide with 2 at No. 3, and so of all the rest. Hence, from *n* to 1 of No. 1 is the length of the first short rib, whose plan is at *a*; from *n* to 2 is the second short rib, whose plan is at *b*; from *n* to 3 is the third short rib; its plan at *c*: from *n* to 4 is the fourth short rib; its plan at *d*: and from *n* to 5 is the fifth short rib; its plan at *e*. The long ribs are taken from No. 2 in the same manner; each of which has its plan laid down at No. 3, as *a b c d e f*, so that I need not say any thing more on this part of the subject. For the length of the hip ribs, take from *p* to 5 at No. 3, and allow three-quarters of an inch for dovetailing into the center block.

*General Observations on the Management of Hip Domes
for State Beds.*

These kinds of domes should be made in four parts, for the sake of convenience in fixing up, or for more easy conveyance into the country. The center block should therefore be made in four quarter parts, on account of the hip and center ribs which are fixed into it, that the four quarters of the dome may easily be separated and put together again without injury. Domes in four parts must therefore have eight hip ribs, or two at each angle, mitring together, to which the ribs of each separate quarter are fixed. For the footing of these ribs a sham or upper tester should be formed, about three inches in breadth, which will give room beyond the ribs to screw it to the under tester.

When the four quarters of the dome are thus formed by ribs, a covering of thin deal, like Venetian shade stuff, should be provided, and after covering both inside and outside of the dome, the deal may be fixed over with thin glue, to strengthen it. After the size is dried, then good canvas may be glued or pasted on, both inside and outside of the dome, which will add to its strength, and give smoothness to its surface. The outside of the dome may then be painted, to match the furniture of the

bed, and the inside is always lined with whatever kind of stuff the hangings are made of.

The inside of the dome should have neat gilt mouldings up the hips, both for ornament, and to hide the joint which is occasioned by the mitring of the quarters together. And from the spring of the dome, or round the under tester, should be an ornamented architrave, which will receive and hide the lower end of the hip-mouldings, and will also cover the tacking of the inner valence, as well as contribute to the grandeur of the effect of the whole. To these ornaments should be added a richly carved patera, fixed to the center block of the inside of the dome, which will also receive and hide the upper ends of the hip-mouldings before mentioned. Lastly, a stuffed head-board, in a gold frame, with foliage ornaments on the top of it, in imitation of a pediment, will add greatly to the effect of the whole, and harmonize with the other enrichments absolutely necessary for a state bed.

For the outside ornaments of a bed of this kind, great care should be taken to avoid every thing that would appear trifling. The pillars should be massy as well as tall, suited to support the dome, whilst height gives room and effect to fine drapery. Sometimes the pillars are white and gold, and sometimes all gold; or the ground of the ornaments may be of the colour of the silk, &c. of which the hangings are made. If emblem-

matical ornaments are introduced in the cornice, or on the top of the dome, those descriptive of unity, love, and innocency, should be studied; and those of war, strife, or other irregularities of the human passions, should be avoided.

Noblemen's crests may be introduced, as serving to distinguish the different branches of families; but, in my opinion, not as they relate to armory.

The height of a state bed may be varied according to the different heights of rooms they are to stand in. However, they never should be less than twelve feet to the top of the dome, including a vase. Nor should they, in my opinion, exceed fifteen feet, not even where a room would admit of it. For then the ornaments of the cornice and dome would lose their effect through distance, and the whole composition would appear as if loftiness were the greatest beauty.

The length of a state bed may be seven, but sometimes eight feet, when the area of a room is extensive.

The width of these beds is in general about one foot short of their length, but sometimes they are made nearly square.

The height of the frame, including the castors, is fourteen inches.

French castors are the best for the purpose, fixed upon a strong iron plate, screwed to the under edge of the sides and ends, so that the castors may run clear of the pillars, and be detached from them, by which their rise is hid from the eye.

These are remarks made from my own experience in the business, which I offer for the assistance of the candid workmen of both branches; but the snarling critic may reject them if he please.

PROB. XXXIII. FIG. 36. Plate VII.

To construct an Elliptical Dome.

Operation.—Let A B, D E be the plan of the tester, whose inside forms a true ellipsis by the help of angle pieces framed in, which must be evident to every workman.

The oval being thus formed according to the inside length and breadth of the tester, and the two diameters being already drawn, proceed with one quarter of the dome thus: draw the plan of the upper tester, into which the ribs are to be fixed, as the second elliptic line shows. Divide then the portion of the
ellipsis

ellipfis between *o* and *l* into as many equal parts as it is required to have ribs in one quarter of the dome, as at *o a b i j k l*, tending to the center *b*.

From these center lines draw parallel lines on each side, which shall determine the thickness of the ribs, and at the same time show how broad each rib will be required, in order to give it its proper twist so as to suit the ellipsis; for here it must be observed, that every rib, excepting the one that is upon each semidiameter, must have a winding form, both inside and outside, in proportion to the length of the oval with its breadth.

Determine, next, how much the dome is to rise from the tester, which, in this example, I consider to be equal to half the short diameter; and therefore the arch of the rib B is a quadrant of a circle, drawn from the center *b*. This arch will serve for two ribs, that is, B and its opposite. Likewise, from the arch B, we determine the outline of every other rib thus: divide the semidiameter *ab* into five and an half equal parts, and raise perpendiculars till they touch the arch B. Divide the plan of the rib *ab* at No. 2 into the same number of equal parts, and raise perpendiculars at pleasure; to which perpendiculars transfer the several lengths of those at No. 1 to the corresponding ones at No. 2, as *acdefg*; by which the rib A will be formed. The ribs for *bij* and *k* are formed in the same

same manner, and therefore it is unnecessary to describe these.

Observe; C, on the plan of the elliptic tester, is for the long center rib and its opposite, as will easily be understood by inspecting the figures, and a little reflection on the subject.

Of the Management of Elliptical Domes.

These domes may be made in four parts, the same as hip domes, if required.

The ribs of these domes are all dovetailed into a center block, which may be circular or elliptical to suit the dome, and which serves for the ground of a carved and gilt patera for the inside of the dome, as has already been mentioned on hip domes.

When the ribs are all completely fixed, the spaces between them may be filled up by glewing white deal in; and when the pieces of deal are worked down to the ribs, the whole will form an agreeable dome, which should be covered with canvass, and painted to suit the furniture, or otherwise covered with the same kind of stuff. And if so, it will be unnecessary to cover it with canvass; but as the stuff must be put on the dome in so many

many breadths, cut so as to answer its shape, a gimp may be stitched on to hide the tacks and give the dome a more rich appearance. But if the dome be large, it may have small gilt moulding in place of the gimp, which are fixed to the dome by gilt-headed screws.

For the inside of the dome, it will be requisite to have a gilt moulding, to hide the joining of the under and upper tester, and to serve as an architrave to the dome.

The triangular compartments at each corner of the tester, occasioned by the manner of framing it to suit the dome, should have small mouldings put on to suit that shape, which will take off the flat and heavy appearance it would otherwise have, and add to the effect of the whole. As for any other particular with respect to ornaments, what has already been observed on hip-domes may also be applied here.

With respect to the dome described by Fig. 37, I do not think it necessary to go through an explanation of it after what has been said on Fig. 35, which, if the reader has fully understood, he cannot fail to be acquainted with the lines laid down in Fig. 37, merely from inspection, especially as I have marked each corresponding line with similar letters and numbers.

SECTION VII.

Of the Proportion of the five Orders, adjusted by Modules, Minutes, and aliquot Parts; together with some Account of their Antiquity and Origin. Also of the general Proportions of Frontispieces adapted to each Order: .

INTRODUCTION.

I HAVE no doubt but it may be thought unnecessary by some to introduce the orders of architecture into this work, after so many publications of this sort by men of the first class in the profession of this art.

To remove this objection and unfavourable impression from the mind, I shall just mention two or three particulars which induced me to make the five orders a part of this Drawing-Book.

First:—In my opinion, and it is presumed that I am not singular in this, nothing can appear more worthy of a place in a complete drawing-book than the five orders accurately laid down and neatly engraved; by which we see the proportions and effect of each moulding arranged and connected

ned together, according to the compositions of those ancient architects of Greece and Rome, who are so justly famous in the world. .

Besides; from a Plate of the above kind, we are not only made acquainted with the proportions and shape of each moulding, but have likewise the advantage of seeing the effect of light and shadow produced by the sun's rays falling in a certain direction on the several parts of a column.

The knowledge of these particulars must ever be considered as essential parts of good drawing, in which architecture is often introduced, and sometimes makes the principal figure.

Second.—As many cabinet-makers, and even some ingenious upholsterers, are found desirous of having a knowledge of the five orders, and the proportions of the several frontispieces, I thought an attempt of this sort would be favourably received, as it undoubtedly tends to make the work more generally useful, and will prevent the trouble and expence of having recourse to other books on the subject. . And this has not been merely my own opinion, but the sentiment of some well-wishers, who desired me to let the orders have a place in my book.

Lastly.—Besides the reasons just mentioned for publishing the five orders, I must frankly own myself a lover and admirer of those ancient productions of ingenuity and art, which, in my opinion, cannot be much, if in the least, improved by the force of modern genius.

If, therefore, the author considers himself as a kind of devotee or bigot to these remaining monuments of ancient ingenuity, surely he may be granted the liberty of paying the following small tribute to the memory of those great architects who had the honour of bringing the five orders to that perfection which we now see them in at this day.

And further, as I believe that the orders are now brought to such perfection in their proportions, as will bear the strictest mathematical examination, I consider them as incapable of improvement, except perhaps in some part of their ornament, and therefore they are classed with those things in this book that will remain unalterable.

Of the Origin and Antiquity of the Order of Architecture.

SOME distinction is to be regarded between the origin and antiquity of the orders, and that of architecture * in general.

The first ideas of architecture in general, may perhaps be traced from those rude and irregular methods of building tents and huts which were the first habitations of man.

But in these structures, nature and necessity were their only guides, unless they obtained some instructions or hints from the manner in which birds build their nests, as Vitruvius conjectures.

We are informed by Moses, that Jabal was the father of such as dwelt in tents: and I suppose it is meant, that he was the first maker of them likewise. And I further imagine, that the city which Enoch built about that time was an assemblage of those tents, perhaps surrounded by a mud wall, and so ob-

* Architecture implies the science of building in general, which gives rules for designing and raising all kinds of structures or edifices. It is from the word architect, compounded of *αρχος*, *archos*, the principle, and *τεκτων*, *tektan*, the chief artificer, or one who gives rules for, and directs the management of, buildings.

tained the name of a city in those days; for it can scarcely be thought that they had at that time either discovered stone, or knew how to make brick, and much less how to put them together in houses, so as to form a city according to those mentioned in after times.

But, however, very early after the flood of Noah, we read of an attempt made to build a city and tower whose top was to reach the heavens. Their materials were then brick, and slime for mortar. And when we consider how great their design was, and how successfully they proceeded until the Divine Hand stopt them, we must necessarily infer, that men in these days began to know the rules of building, and of course this may be considered the origin of regular architecture.

But the origin of that part of architecture called the *five Orders*, is of much later date than this. They appear to me, and it has been the opinion of some great architects, that they owe their beginning to Solomon's Temple.

I do not mean that pillars or columns were never in use before this famous building was erected, but only that we do not read of certain proportions assigned to their height and diameter till those given to Jachin and Boaz, the names of two pillars set up at the entrance of the porch of this building.

We

We read of pillars above four hundred years before the days of Solomon: and we read also, that these pillars had chapiters and fillets of gold and silver; but no mention is made of their height* or diameter; yet something may be known as to the intercolumniation of these pillars, for there were twenty pillars standing in an hundred cubits, the length of each side of the tabernacle. See Exod. xxxvi. 38. and xxxviii. 11. However, as there are no proportions assigned to these pillars, I presume we cannot date the origin of the orders here; yet I think there would be more plausibility in it than what some have advanced on this subject.

The pillars which Solomon erected at the entrance of the temple were of the following proportion, according to the language of the scriptures:—Their height was eighteen cubits, or twenty-seven feet without their chapiters or capitals; and their chapiters were five cubits; which in all makes thirty-four and an half feet in height. A line of twelve cubits did compass either of them about, consequently their diameter was six feet; and had these pillars been one cubit higher, their proportion would have answered exactly to the original Doric Order, whose height was equal to six of its diameters.

Besides

* Josephus indeed says, " Every pillar was five cubits in height;" and he speaks also of five pillars at the entrance of the tabernacle, that were gilded, and stood on bases of brass.

† For some time after the first invention of this order, the proportion of its diameter to the

Besides the likeness or affinity between the Doric column and those set up by Solomon, will still appear more striking, if we consider that the ancient Doric had no plinth or base; for does not appear to have been any at the foot of Jachin and Boaz, otherwise I think they would have been mentioned as well as the chapters. But these columns are said to have fillets, whose thickness was four fingers, and they were made hollow. See Jer. lii. 21.

These fillets seem to answer well enough to the Doric necking at the top of the shaft. They were hollow, and of four fingers thickness or projection, which is nearly the same projection as would be required in the necking of a Doric column of the dimension of Jachin and Boaz.

There is another particular which may be mentioned which also bears some likeness to the Doric, and that is the size of the porch or entrance, on each side of which these massy pillars were placed.

This opening was twenty cubits in width, and forty in height, answering to the proportion of the Doric frontispiece or door.

the height was as the length of a man's foot is to the height of his whole body, which at that time was reckoned to be one sixth part; but afterwards they added another diameter, and at length brought it to eight.

And lastly.—The lily-work on the chapiters, and the rows of pomegranates round about the chapiters, were, in my opinion, as likely to have given rise to the ancient Doric order, and more so than the manner of building ancient huts, by placing trunks of trees on each side, by which the roof was supported.

Yet I will not say but trunks of trees thus employed, might first give existence to the notion of some kind of a pillar to be used in the first buildings of brick or stone, while, at the same time, I am inclined to think that columns were never reduced to any order till the building of Solomon's temple by God's appointment.

However, it is not to be understood as if the regular Doric order could be copied from Solomon's pillars, but only such hints and proportions taken from them as served in after times to compose the first order of architecture.

Nor can it be thought that the first composition of the Doric column had these triglyphs and mutules which we now see it has, till after it was reduced to its proper form and character. It is therefore thought to have been more simple and massy in its primitive state; something like the Tuscan order. Some
 imagine.

imagine, and not without ground, that the Tuscan, nearly as we have it now, was the first state of the Doric.

Vitruvius speaks of a state in which the Doric column was in before it was reduced to order; for, treating of the antiquity of the Doric, that it was used in the temple of Juno, at Argos, he says, that “ the same order was also used in the other cities of Achaia, before the laws of its symmetry were established.”

This indicates that it was in a more rude state before it was employed in that famous temple.

But if that temple, dedicated to Juno, was erected in the days of Dorus, the king of Argos, as Vitruvius intimates, it would be rather incredible to think that the Doric order should be in existence in times so long before Solomon*: and, upon such a supposition, those who maintain that the first idea of the orders was derived from Solomon’s temple, would be grossly mistaken.

A certain author, after quoting Vitruvius on the subject, says, “ Such is the account given by Vitruvius of the origin of

* Dorus must have been, at least, four hundred years before Solomon, if he reigned at Argos before the expedition of the Argonauts.

improvements in the proportion of columns. Had improvements, however, existed in such early times, Homer, who was greatly posterior to them, would certainly have made mention of something of the kind; but in all his writings he gives us no account of any thing like columns of stone, but uses a word which would rather incline us to think that his columns were nothing more than bare posts."

This account looks as if there had been neither stone columns nor temples till after Homer's days. For if the architecture among the Greeks in those days consisted of bare posts, we cannot suppose that those magnificent temples which they dedicated to their gods were so poor and plain; neither can we imagine that if there had been such fine temples in his time, that he would have left them unnoticed. It would seem as if the Greeks had borrowed their first notions of temples to worship their gods in, and also their architecture to adorn them with, from that at Jerusalem.

Agreeable to this view, the above quoted author says: "It is remarkable that improvements in architecture did not take place in any nation till after, or about, the time that Jerusalem was taken by Nebuchadnezzar. The grandest buildings amongst the Assyrians seem to have owed their existence to this mo-

* Homer was born above nine hundred years before the Christian era.

narch; and it can scarcely be imagined that he would not endeavour to imitate the architecture of Solomon's temple, to which, by his conquest of Jerusalem, he had full access*."

Upon the whole then, I think it will agree better to the above facts, if we affirm that the Doric order had its name and improvements from the Dorians, who occupied the country of Doris, a Grecian district, of which Dorus had formerly been king.

The Ionic order succeeded the Doric, according to antiquity, and was an improvement from it. It had its name from Ion, the Grecian country or district where it was invented, and first employed in the temple of Diana at Ephesus. By the accounts we have of this temple, architecture must have arrived to a considerable degree of perfection in these times. This temple at Ephesus, the metropolis of Ion, was about four hundred and forty feet long, and two hundred and thirty feet wide; was supported by one hundred and twenty-seven pillars of the above order, and about sixty-two feet high. It was built in marble, and decorated with the finest ornaments; and, as the history says, exhibited the most perfect model of this order.

* According to Pridcaux, Nebuchadnezzar took Jerusalem six hundred and five years before Christ.

The Corinthian comes next in order, which has its name from Corinth, a city or chief town in Achaia, a Grecian district or territory. In this city the Corinthian order had its origin. The account which Vitruvius* gives of it is somewhat curious and entertaining; I shall therefore transcribe it.

"The third," says he, "which is called Corinthian, is in imitation of the delicacy of virgins; for the limbs are formed more slender, and are more graceful in attire. The capital is reported to have been thus invented:—a Corinthian maid, being seized with a disorder, died; after her interment, her nurse collected, and disposed in a basket, the toys which pleased her when alive, carried it to the tomb, placed it on the top, and, that it might endure the longer in the open air, covered it with a tile." The basket chanced to be placed over the root of an acanthus, which being thus depressed in the middle, the leaves and stalks in the spring season issued outward, and grew round the sides of the basket; and being pressed by the weight at the angles of the tile, were made to convolve at the extremities, like volutes. At that time Callimachus, who, for his ingenuity and excellence in the arts, was by the Athenians named Catatechnos†, happening to pass by this tomb, took notice of the basket, and being pleased

* Vitruvius was an ancient Roman architect, who wrote a system of architecture, it is thought, in the time of Titus, the eleventh Roman emperor, who reigned in the year 79, to whom he dedicates the work.

† The first of artists.

with the delicacy of the foliage growing around it, as well as the novelty of the form, made some columns near Corinth according to this model, and from thence established the symmetry, and determined the proportions, of the Corinthian order."

The Tuscan order is the fourth in point of antiquity, but in the arrangement of the five orders it is put first, on account of its simplicity and plainness. It had its origin in Tuscany, a place remarkable in Italy, which was first inhabited by the ancient Lydians out of Asia. These people first built temples of this order, and dedicated them to their gods in their new plantations. Vitruvius calls it the rustic order, which is consistent enough with what I formerly conjectured, namely, that this order was the first state of the Doric column in its most antique form. And the circumstance of its being brought from Asia by the ancient Lydians, helps to confirm it.

The Composite is the last. Its name denotes that it was composed from the other regular orders.

It is also called the Roman order, because it was reduced to its proportional standard in that country.

It does not appear to be so ancient as the days of Vitruvius, as he makes no mention of it. He speaks of various capitals that might be introduced on the Corinthian column, but does not name them. "There are," says he, "also other kinds of capitals, called by various names, which are disposed on the same columns, and which have ~~no~~ proper symmetry or relation to any order of columns that can be named differently; but they are all derived and transferred from the Corinthian*."

These words, and the liberty they convey in favour of the composition of varieties of capitals to the Corinthian column, it may be presumed, gave rise to the composition of this order, which, in any other respect but the capital, is nearly the same with the Corinthian. Some architects, however, do not incline to speak well of it, because it appears to have been picked and culled from all the other orders, and is sometimes badly arranged, on account of the liberty both taken and granted in this species of architecture. However, in my opinion, it forms a very beautiful appearance when rightly managed.

The original inventor of the composite order is thought to have been one Serlio.

Having now said as much on the antiquity and origin of the five orders, as is necessary to give a workman a proper view

* See Newton's Translation of Vitruvius.

of the subject, I shall now proceed to describe the proportions and character of each distinct order, and likewise explain the names of each moulding.

Of the Tuscan Order. See Plate VIII.

THE Tuscan order is the most simple of any of the orders. It is also distinguishable from the other, on account of its strong and massive appearance. On which account, in the figurative style, it has obtained the name of the rustic order; and in conformity to this character it is generally employed in farm-houses, stables, and other buildings in the like situations. It is, however, sometimes used in grander buildings, where ornaments are not required, but where strength is the principal object.

The proportion of the Tuscan column, with its pedestal and entablature, is as follows: "

Divide the whole height, for the complete column, into five, as the figure shows. Take one of these parts for the pedestal as at 1, whence the line is directed that determines the height of the pedestal. From this line divide the whole height again into five equal parts, as the second upright scale shows.

Take one of these parts for the whole entablature, and the remaining four is the height of the column, including its base and capital. Divide the height assigned for the column into seven equal parts, as is shown on the third upright scale. Take one of those seven parts for the inferior or lower diameter of the column, not including the projections of the base, but simply confined to what is commonly called the shaft, or cylindrical part of the column. Take half of the inferior diameter, and give it for the height of the base, and also for the height of the capital, not including the astragal at the neck. Proceed next to draw a module, by which to determine the smaller parts of the column with the heights and projections of its members, as specified by the upright and horizontal numbers opposite to each member on the large scale.

Draw a right line at pleasure. Lay, on this line, a space equal to one diameter. Divide it into six equal parts, and draw perpendiculars from each division indefinitely. Lay on five equal divisions on any of the perpendicular lines, and draw parallels through each.

Draw then two oblique lines, meeting in a point at half of the first division so, which space will then be divided into ten, at the numbers 1, 2, 3, 4, 5, &c. so that any number of minutes up to sixty may be accurately taken from this scale.

I have also shown a module at the bottom of the larger pedestal, which is equal to two of the small modules, from which all the minutes are taken and placed as beforementioned, as the Plate of itself will make sufficiently clear by inspection.

A module is considered by some as only half a diameter, but others extend it to a whole diameter; which last I have adopted, as being the most simple and entire, and therefore more easily remembered by workmen.

Vitruvius uses the large module, reckoning the proportions of the column by the thickness of the lower diameter of its shaft. And I do not see but it answers as nearly to the different parts of a column as the semidiameter does, or as that of twenty minutes, which has been contrived by some.

The projection of each member is also denoted by aliquot, or equal parts; and each part is equal to a minute taken from the scale; so that if the reader should find any little inaccuracies in the aliquot parts, which it is almost impossible to avoid in such small scales, he may correct these by the numbers. And observe, that the cornice of the pedestal projects $11\frac{1}{2}$ minutes, which is the whole sum of the projection of each member, denoted by 2, 4, 3, $2\frac{1}{2}$, and which amount to $11\frac{1}{2}$. The base of the pedestal projects the same. Its fillet is two parts; the ogee, or cyma-recta, seven and an half; and the square two; which is in all eleven and an half. * The base of the column projects ten; the

The conge, or apophyge, four; and the torus fix. The upper conge of the neck of the capital three, and its astragal one and an half. The capital, in all, projects twelve minutes; the first fillet two, the ovalo seven, the abacuo one before it, and the upper fillet two. The whole projection of the architrave is five, the upper facia one and an half, and its fillet projects three and an half. The whole cornice projects forty-five minutes, and its height is equal to its projection.

Of the Diminution of Columns.

SOME diminish columns by a right line drawn from the inferior to the superior diameter; but this is very jejune and insipid, because when columns are finished strictly in this mode, they appear too slender in the middle, and lose that graceful effect which an easy curve line produces.

It appears that some of the ancients diminished the shafts of their columns by a curve line one third from the base, as in Plate VIII. whilst others of them carried this point to an extreme, by drawing a regular curve line from the inferior to the superior diameter, producing a diameter in the middle of the shaft larger than that at the bottom. This notion has been

charged upon Vitruvius, because he speaks of “ an augmentation that should be made in the middle of columns;” but Mr. Newton, in a note in his book of Vitruvius, has cleared him of this charge. See page 53. And Sir William Chambers takes notice of an author who supposes the “ addition mentioned by Vitruvius to signify nothing but the increase towards the middle of the column, occasioned by changing the straight line which at first* was in use, for a curve.”

“ This supposition,” says Sir William, “ is extremely just, and founded on what is observed in the works of antiquity; where there is no instance of columns thicker in the middle than at the bottom, though all have the swelling hinted at by Vitruvius, all of them being terminated by curves.”

The method that this gentleman recommends as most proper for diminishing columns, is by an instrument which Nicomedes invented to describe the first conchoid; for this, being applied at the bottom of the shaft, performs at one sweep both the swelling and the diminution; giving such a graceful form to the column, that it is universally allowed to be the most perfect practice hitherto discovered.

* This means, before the orders of architecture had received much improvement.

This method has been adopted in the diminution of the Ionic, Composite, and Corinthian columns in Plate X, XI, and XII; because these are the most delicate orders.

But, in the Tuscan and Doric shafts, I have followed the common method; because these robust columns will admit of more apparent, or more sudden diminution than the other three.

The most common method is as follows. See Plate VIII.

Divide the shaft into three equal parts, and draw a diameter at the first part. On this diameter describe a semicircle, and divide the semidiameter into five equal parts. From the fourth division raise a perpendicular line which determines the upper diameter and cuts off a portion of the semicircle, which is to be divided into four on the curve. Lastly, divide the upper two thirds of the shaft into four equal parts, answerable to the four equal parts on the curve; and from each of these divisions, or parts, on the curve, draw right lines to the corresponding divisions on the shaft, by which, four points will be found through which the diminishing curve line is to pass, and, if accurately drawn, will appear smooth. Observe, this diminution brings the column, at its superior diameter, to forty-eight minutes;

but in all the other orders there are uniformly fifty minutes allowed.

Some architects, however, contend for various degrees of diminution, according to the character of each column. They assign to the Tuscan one fourth, to the Doric one fifth, to the Ionic one sixth, to the Composite and Corinthian one seventh, of the inferior or largest diameter.

This makes no difference, however, in the method of diminution above taught; for if the Tuscan be diminished one fourth, then divide a semidiameter into four parts, and take one of those for the diminution on each side, and proceed as before; so also of the other.

I shall now quote a few words from Sir William Chambers on this subject, by which the reader, if he please, may form his judgment. He says, " In the remains of antiquity, the quantity of diminution is various; but seldom less than one eighth of the inferior diameter of the column, nor more than one sixth of it. The last of these is by Vitruvius esteemed the most perfect. Vignola has employed it in four of his orders, as I have done in all of them, there being no reason for diminishing the Tuscan column more in proportion to its diameter than any of the rest."

How

How to diminish any Column, from the inferior to the superior Diameter, by means of an Elliptic Curve not exceeding in its Swell the inferior Diameter.

FIG. 1. Plate XIII. is Vignola's method of diminishing a column, the principles of which I have taken from Sir William Chambers' Treatise on Architecture, but have here described it in my own way, as follows. Determine the height of the shaft as at cd , and draw a line for its axis. Next, draw ba at pleasure, and at right angles with the axis. Let bc be half the inferior, and nd half the superior diameter. Take bc half the under diameter, and with the compasses place it from n , the extreme point of the upper diameter, to any point where it falls on the axis of the column, as at o . From n draw a line through o , and proceed till it cut the base line ba at a . Draw a line at pleasure from b , the extreme point of the inferior diameter, parallel with cd ; and divide this line into a number of equal parts, as 2, 4, 6, 8, &c. From a , the center, draw a ray or right line to each of these divisions, which will pass obliquely through the axis, in proportion to their distance from the inferior diameter bc . Take then bc , half the diameter, and place it from 1 to 2, from 3 to 4, and so on of all the rest. Lastly, through each of these points draw a curve line, and the diminution

diminution of one side of the column will be thus completed, as is shewn by the dotted line on the right hand. To determine the other side of the shaft, nothing is wanted but to draw a square line across the shaft from each point, and place the distance $2x$ to x , and $t4$ to $t9$, and so on of the rest.

Fig. 2. is Nicomedes' instrument, which, as it is here described, is intended to perform the same diminution as has been above explained by lines.

This instrument is made in the manner of a square, with a stay to keep it firm, as at R ; bp is a dovetail groove cut in the center of the upright piece, as T ; ba is its base, in which also there is a dovetail groove as at u ; iw is a ruler, or trammel, which moves by the dovetail-piece y in the groove bp , by which the diminution is performed; gb is a plain groove cut through the trammel, and g is a center pin which guides the trammel as i passes from p to b ; when i is at b , it is evident that b will be at g the center pin, because bi is equal gb ; also gi is equal oa in Fig. 1. and found in the same manner. The interval, or space, between the center i and k at the end of the trammel, is equal to the inferior diameter bm , or bc , Fig. 1. As, therefore, the center i passes to b , the center k , in which a pencil is fixed, cuts all the oblique lines jj tending to g , in the same points as

at

at 2, 4, 6, 8, &c. of Fig. 1. and at the same time draws a perfect curve, which I take to be of the elliptic kind.

Lastly, in order to make this instrument answer for shafts of various sizes, the plain groove $g b$ must be lengthened each way to v and w at pleasure. The upright $p b$, and the base piece $N a$, must also be proportionably lengthened; and if the center pin g be fixed in a moveable piece to slide each way in the groove u , and fixed at any certain place by a screw, as may be required, then it is evident that the instrument may be so constructed as to answer columns of any dimension.

Of the principal Parts of a Column, and the Names of each Member.

THE principal parts of an entire order are three; the pedestal, shaft, and entablature.

The pedestal is the lowermost part of an order, comprehended between y and F , see Plate VIII. The column is the middle part of it, including the whole space between the pedestal and top of the capital. The entablature is the uppermost
part

part of the whole, and contains every member between *m*, the top of the capital, and *a*.

These principal parts are again subdivided as follows. The pedestal contains the plinth F, dado B, and cornice A, *z*, *y*. The column includes a base, shaft, and capital; and the entablature, an architrave, freeze, and cornice.

Thus, in every entire order there are three principal parts, and each of these parts are again subdivided into three smaller parts, which in all make nine; the origin of whose names is as follows:

F, the plinth, is from *πλαῖος*, *plinthos*, a brick, or flat square stone, on which columns, in their most antique state, are supposed to have stood.

B, the dado or dye, so called because it is of a cubic form.

A, *z*, *y*, the cornice, from the Latin *coronis*, a crowning; because the cornice is the finishing, or crowning, of the pedestal.

x, w, v, the base of the column, from *βασίς*, *basis*, a foundation or footing for the column.

The shaft is that long and straight part of a column comprehended between the base and capital.

Some derive it from *σκαπίζω*, *skapto*, to dig, in the manner of a well, round and deep, whose inside resembles the shape of a pillar; and some from the long part of an arrow or shaft*.

q, p, o, n, m, the capital, from *κεφαλή*, *kephale*; or *caput*, the head, which the capital is to the column.

l, k, i, the architrave, so called because it is the chief support to the whole entablature, from *αρχος*, *archos*, chief or principal; and the Latin *trabs*, a beam.

b, the freeze, “ from *φίβρον*, *phibron*, a border or fringe; or which the ancients used to call *ζωφορος*, *zophoros*, because it was usually enriched with the figures of animals.”

From *g* to *a* is called the cornice, which is the same to the entire order as the pedestal cornice is to it. See A, *x, y*.

* The shaft of a mine is the round perpendicular passage they make to come at the ore.

These subdivisions of the entire order have each their particular members, except the dado or freeze; and on the proper arrangement of these members depends much of the beauty of the whole.

The names of these members are as follows :

a, the fillet, from the French word *fil*, thread.

b, the cymatium, or cyma-recta, from *κυματιον*, *kumation*, a wave; because this member resembles the swelling and concavity of a wave.

c, the fillet.

d, the corona, or crown; because it is a principal member of the cornice, and serves as a shelter to the smaller members of the entablature.

The hollow part appearing at the underfide of the corona, is termed the *drip*.

e, the ovolo, or Latin *ovum*, which means an egg; because this member, in the Ionic, Composite, and Corinthian orders, is generally carved in the shape of eggs and darts.

g, the

g, the cavetto, from the Latin *cavus*, hollow.

i, the fillet, listel, or square of the architrave.

k, the upper fascia ; and *l* the lower ditto.

m, the upper fillet of the capital.

n, the abacus, from *αβαξ*, *abax*, a shelf or table ; or, as some suppose, a tile on which the ancient Greek mathematicians strewed dust to draw their geometrical schemes on.

This word seems to have been introduced into architecture on the invention of the Corinthian capital, which had its rise from an acanthus growing round a basket with a tile laid over it, as has already been described from Vitruvius. Consequently——

o, the ovolo, which is the succeeding member, must be considered as the basket over which this tile was placed.

p, the lower fillet of the capital ; and *q*, the freeze of ditto.

r, the astragal, from *αστράγαλος*, *astragalos*, a bone of the heel; or the curvature of the heel, which this member resembles.

s, the upper fincture, which it is thought was anciently an iron hoop, or ferule, to secure the ends of the columns, when they were used without capitals or bases.

t, the upper conge or apophuge, from *αποφυγή*, *apophuge*, escape; because that part of the column appears to fly off.

u, the lower ditto; and *v*, the lower fincture.

w, the torus, from *τορὸς*, *toros*, a cable, which this member resembles.

x, the plinth of the base.

y, the fillet; and *z*, the corona, as before.

A, the cyma-reversa, or the cymatium inverted.

DE, the base of the plinth, whose members are named the same as those of the like shape already described.

In every other column similar members have the same name, and therefore I shall not repeat them over under the other columns. But as there are some members in the succeeding orders which differ in character and shape from those that have been mentioned already, I shall here point them out, to prevent future trouble, and to keep this part of the subject of architecture together.

The Doric, Plate IX. for instance, has a scotia marked A, from σκοτια, *skotia*, darkness; because of the strong shadow which is produced by its own concavity and the projecting astragal above it.

m, the conic drops, so called from their figure.

k, the triglyphs, from τριγλυφος, *triglyphos*, three engravings. It is a compound of τρι, *tri*, three, and γλυφω, *glypho*, to carve or engrave; in conformity to which derivation, the triglyph has two entire channels, and two half ones, with three spaces between. It is said that the triglyphs peculiar to this order were first used in a temple at Delphos dedicated to Apollo, because his lyre was of this shape.

e, f, g, the mutule, from the Latin *mutuli*, modillion; so that, properly speaking, the mutules are to the Doric the same as the modillions are to the Composite and Corinthian orders.

In

In the Ionic order, Plate X. there are two members which differ from those already mentioned, as *o* the volute, and *D* the dentils. The volute is so called from the Latin *volvere*, to roll round, as on a staff*. Some call the volutes the horns of the capital, because they pretty much resemble the twisting of rams' horns.

The dentils are from *dentelli*, teeth, which they resemble; and the flat member on which these dentils are placed is termed *denticulus*.

The Composite capital is adorned with acanthus leaves, and the Corinthian with those of the olive.

Of the Character and general Proportions of the Doric Order.

See Plate IX.

THE character of this order is considered by architects as grave and robust. Hence, in the figurative style, it is termed

* The term *volute* has the same origin, because anciently they formed books by sheets of written parchment or bark rolled round a stick.

the *Herculean Order*; of which order some temples were formerly built, and dedicated to Hercules as well as to Apollo.

It is generally used in large and strong buildings, as in the gates of cities, and at the outside of churches. And, as its entablature is of a very large projection, it is generally employed in situations where shelter is required.

The whole height of the entire order is divided into five equal parts; one of which is the height of the pedestal. The column and entablature is divided into five also; four of these parts are assigned for the height of the column, including the base and capital; these four parts are again divided into eight equal parts, one of which is given for the inferior diameter of the shaft. The entablature is two diameters in height, its cornice is forty-five minutes, and its projection is one module. The shaft sometimes is left plain, and sometimes it is fluted. The number of flutes is twenty or twenty-four, and the depth and curvature of them are determined by drawing an arch from the summit of an equilateral triangle, whose sides are equal to the breadth of the flutes, as at *a*.

To diminish the flutes in proportion to the column, divide the upper two-thirds of the shaft into four, and find the semicircles 1, 2, 3, 4, 5, in the same manner as was taught in the Tuscan order. Then divide each of these semicircles into ten

or twelve, and draw the flutes on each semicircle from the summits of equilateral triangles as above. Lastly, as the Doric flutes have no fillets, all that remains is to draw a line from each point where the flutes meet, from one semicircle to the other, and the lines for the flutes will be thus determined. And observe, in all the orders a flute must be in the center of a column or pilaster, not a fillet.

The triglyphs are thirty minutes in breadth, see Plate XII. and sixty-two in height, including the conic drops, and the upper and lower fillets, with the small square above the drops. The channels of the triglyphs form a square or right angle, and their breadth is determined by dividing the whole triglyph into twelve equal parts, and assigning two of these parts for the channels, two for the spaces between them, and one for the half channel on each side. The conic drops at bottom are also equal to two of those parts; and if two parts be divided into three, one of these parts will be the breadth of the upper end of those drops.

The metope, or space between each triglyph, is forty-five minutes, or equal to the height of the triglyph without the fillets. These metopes are sometimes adorned with ox skulls or pateras, whose projections ought not to be more than the triglyph itself.

The breadth of the mutules, without their chips, is equal to the triglyphs without their fillets.

The projection of the mutule is the same; and the soffits, or undersides of the mutules, are sometimes ornamented with drops of the same kind as those of the triglyphs.

The soffits of the corona are also enriched with roses in square, and in *lozenge compartments, cut out of the solid, including in their depth the whole relief of the ornaments.

With respect to the heights and projections of each member, these must be learned from the upright and horizontal scales, and therefore it will be unnecessary to say more.

Of the Character and general Proportions of the Ionic Order.

See Plate X.

THE Ionic is more slender and graceful than the Doric. Its ornaments, in my opinion, are truly elegant, being in a

* In the figure of a rhomb. See Plate II. fig. 3.

style of composition between the richness of the Corinthian and the plainness of the Tuscan order: for which reason, in the figurative style, it has been compared to a sedate matron, in decent rather than rich attire.

This order, being of a grave cast, is often employed in courts of justice, and in the inside of churches, and other places of that kind: in libraries and colleges also, and in all places that belong to arts and letters.

The general proportions are as follows:

The height of the entire order is divided into five equal parts. One part is given for the pedestal, and the remaining four are divided into six; one of which is assigned for the height of the entablature, and the remaining five will be the height of the column, including the base and capital. The height assigned for the column is then divided into nine, one of which is for the inferior diameter or module.

The cornice is forty-four minutes high, and its projection is equal to its height. The drip in the under side of the corona is channeled out one minute deep within two of the front, and one minute before the cyma-reversa.

The

The shaft of the column is sometimes fluted, and sometimes plain. Twenty or twenty-four is the number of flutes allowed, and their fillets are one third of the width. The depth of the flutes is determined by a semicircle whose diameter is equal to the width of them.

How to describe the Ionic Volute.

See PLATE XIII. FIG. 4.

Operation.—Draw the perpendicular As , and make As equal to fifteen minutes. On the center s describe a circle whose diameter shall be equal to three and an half minutes. Draw next a geometrical square, having its sides equal to the radius of the circle, as 1, 2, 3, 4. From the angles 2, 3, draw a right line to the center of the circle, as at s . Divide the side of the square 1, 4, into six equal parts, as at 5, 9, 12, 8. From 5 draw the line 5, 6 parallel to 1, 2; draw 6, 7 parallel to 2, 3, and 7, 8 parallel to 3, 4. In the same manner draw 9, 10, 11, 12, and twelve centers will be found, as at 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12; by which every arch of the volute will be accurately drawn, and each of them coincide with the other—thus: on the center 1 fix one foot of the compasses, and extend the other to A : with

this opening sweep the arch A B. On the center 2, with the compasses extended to B, sweep the arch B C. On the center 3, with the compasses extended to C, sweep the arch C D. On the center 4, with the compasses extended to D, sweep D E, and the volute will be turned once round. For the second time round, begin at center 5, and extend the instrument to E, and sweep E G. On the center 6, with the compasses at G, sweep G H. On the center 7, with the compasses at H, sweep H I. On the center 8, with the compasses at I, sweep I K, and the volute will be turned twice round.

The third time round begins with center 9, from which extend the compasses to K, and sweep K M. On the center 10, with the compass foot at M, sweep M N. On the center 11, with the compass foot at N, sweep N O. And lastly, on the center 12, with the compass foot at O, sweep O P, which will complete the volute three times round.

Observe, that the whole volute is composed of twelve quadrants of a circle, drawn from twelve centers, and gradually contracted in by means of the diagonal lines in the eye, see Fig. 3. Therefore, as there are three complete turnings in the whole convolution, each of these turnings is made up of four quadrants.

How to graduate the List or Fillet of the Volute.

MAKE the breadth of the fillet at A equal to two minutes; or, according to some, one and seven eighths, or one and two thirds. Construct a triangle, as at Fig. 5, whose sides A P, V P, shall be equal to the length of the cathetus, or upright line A P, Fig. 4. Make A V, Fig. 5, equal to half the side of the square in the eye of the volute, Fig. 4. Draw then the line L S, Fig. 5, at a distance from A V, equal to the breadth of the fillet at A, Fig. 4. Take the length L S from Fig. 5, and place it each way from S in the eye of the volute, or as from V to S in the large eye, Fig. 3. V S is divided into three equal parts, which are shewn by the dotted lines; and where these dotted lines intersect with the diagonal lines in the square, they will find twelve new centers, which will describe the diminution of the list or fillet by the same process that was used in drawing the exterior contour or outline of the volute above explained.

For the other enrichments of the Ionic capital, see the plan in Plate XII. and observe, that over every flute in the shaft is placed an ove, or egg, in the ovolo.

Of the Character and general Proportions of the Composite Order.

See Plate XII.

THIS order is generally placed last of the five, because it was a composition from them, and of the latest invention. But, according to this reasoning, the Doric should be first in order, because it was the most ancient; however there are two reasons which have induced me to place the Composite as the fourth. First, because it is the fourth when orders are placed upon orders in large and magnificent buildings, where it is observable that the more massive and plain columns are nearest the foundation, as first the Tuscan, second the Doric, third the Ionic, fourth the Composite, and last the Corinthian. Second, because it is the fourth in point of richness and delicacy, for as they decrease in strength they increase in richness of ornaments; their elevation above the ground is therefore regulated both by degrees of strength and richness of composition. But to give a proper sanction to this little novelty in the arrangement of the orders, it may be proper to quote some great man of this opinion. Sir William Chambers* says, " Most authors give the

* From whose excellent *Treatise on Architecture* I have borrowed some of the proportions which are found in my orders, as also from Mr. Richardson's.

last place to the Composite order, as being the last invented, and a compound, which of course ought to be preceded by all the simples. I have followed Scamozzi's method; his arrangement appearing to me the most natural; for his orders succeed each other according to their degrees of strength, and in the progression that must absolutely be observed whenever they are employed together."

The proportions of the Composite, and its enrichments and delicacy, being nearly the same with that of the Corinthian order, in the figurative style it may be properly enough termed one of the virginal orders, and was therefore used in some temples of the female deities.

It is, however, generally employed in triumphal arches, for as the Romans composed this from the Græcian orders, so they made use of it in those situations to express symbolically their conquests over those nations. I have therefore, in conformity to this, represented a trophy of war in the freeze, which I think would have a good effect placed over the center of each column, with other ornaments between them suited to the character of this order.

The Composite may also be employed in monuments of signal events, and in such buildings as are intended to perpetuate

petuate the memory of the great actions of particular persons.

The general proportions of this order are as follows:

The height of the entire order is divided into five, as usual; one of which is appropriated for the height of the pedestal. The remaining four is for the height of the column and entablature. These four parts being again divided into six, the upper one is assigned for the height of the whole entablature, and the remaining five of these parts are for the height of the column, including the base and capital. The height of the column is divided into ten equal parts, one of which is for the inferior diameter. The base is thirty minutes, without the upper astragal; and the capital is seventy minutes high, adorned with the acanthus leaves, and volutes drawn by the same method as that of the Ionic. The plan of the capital being drawn in the same manner as that of the Corinthian, I shall explain the particulars of it under that order.

The soffit of the corona is divided into square compartments, cut out of the solid, decorated with roses, &c. whose relief must not project more than the borders which inclose them. In rich compositions the soffits of the modillions are also ornamented, but their relief is not to exceed the horizontal surface, otherwise

otherwise it would greatly injure the effect of the modillion, and render the appearance of the profile of the entablature less pleasing.

Of the Character and general Proportions of the Corinthian Order.

See Plate XII.

THE Corinthian, or last order, is certainly the most rich and graceful in its appearance of any other. To speak in the figurative style, it has all the delicacy of a female youth, and has therefore been termed the verginal column or order; on which account it is employed in the apartments of young ladies: but, for its richness and grandeur, it obtains a place in the palaces of kings, and the most superb buildings. It is also used in public squares, and all places of gaiety.

The general proportions of this order are as follows:

The whole height of the entire order is, as in all the others, divided into five, and one is given for the pedestal. The remaining four are then divided into six, and one part is assigned

to the whole height of the entablature. The four parts which are left include the height of the column, with its base and capital, and are divided into ten equal parts, one of which is given for the inferior diameter of the shaft. The base is thirty minutes high without the upper astragal, and the capital is seventy minutes clear of the necking. The cornice is forty-eight minutes in height; and its projection the same.

. The soffit of the corona is worked in square compartments, as in the Composite; but the under sides of the modillions are ornamented with an olive leaf, the same as in the capital. The abacus of the capital is sometimes fluted, and sometimes plain. The volutes sometimes rise higher than the under side of the abacus, but the capital looks best when they are bounded by the under surface of the abacus.

The plan of the capital, and the position of the leaves as they appear on the round surface of the capital, are thus determined.—Let de , in Fig. E, be equal to the inferior diameter of the column: sweep the arch eg at pleasure; then bisect the arch by turning the sweeps da on the centers eg ; draw do , the angular line of the capital.

From the angular line place five minutes each way, as at m and n . Take mo , and place it from a to o ; then take the

whole space *mo* in the compasses, and sweep an arch each way intersecting at *p*. From the center *p*, sweep the front of the abacus *mt*, and so of all the other sides of the capital.

Take half the superior diameter of the shaft, and with it sweep the arch *cre*; then extend the compasses seven minutes further, and sweep the arch 7, which determines the projection of the first row of leaves. Lastly, extend the compasses to six minutes further, and sweep the arch 6, which will determine the second row of leaves. Divide the quadrant *cre* into four equal parts, and draw the radii *dc*, *dr*, *de*, which lines will determine the stem of each leaf. From the centers *ce*, draw semi-circles, as they appear in the plan.

From *cre* let fall perpendiculars, and the points 1, 2, 3, 4, will determine the situation of the leaves in the capital. Therefore take the distances 1, 2, 3, 4, from the plan E, and place them on the capital, as 1, 2, 3, 4, each way from the center; and from these raise perpendiculars, which will be the apparent place of the stem of each leaf. How the leaves are formed must be evident by inspection, and therefore I shall not enlarge further on the subject.

How to draw the Scotia Moulding.

FIG. *c* is the scotia, whose height, without its fillets, must be divided into seven. On the fourth division draw a line *rd* parallel with the fillets. Take the upper three parts in the compasses and draw a circle. Make *da* equal *dn*, or four parts. From *a*, draw *arp* indefinitely, cutting the aforesaid circle at *p*. Lastly, fix the compass foot at *a*, and extending the other to *p*, sweep the arch *pn*, and the scotia will be completed.

The cyma-recta A is drawn from the summits of equilateral triangles thus: draw *vw*, and bisect it at *x*. Extend the compasses' *x* to *v*, and turn two arches at 3, and their intersection is the center for the convex part. In the same manner *y* is the center for the concave part, which completes the moulding.

How the cyma-inversa B is drawn, must be evident by inspection; and with respect to any other kind of moulding, they are either considered as quadrants, or as semicircles, or nearly so; as the astragals, torus, ovolo, conge, and cavetto.

Observations.

Observations on the Agreement of the Five Orders to each other.

THE height of every entire order is divided into five equal parts; of which one is given for the height of the pedestal, and the remaining four are for the column and entablature.

In the Tuscan and Doric orders these four parts are divided into five, the uppermost part of which is for the height of the entablature; and the remaining four in the Tuscan, are divided into seven, and one is given for the diameter; and in the Doric into eight, and one is assigned for the inferior diameter.

In the Ionic, Composite, and the Corinthian orders, the four remaining parts from the height of the pedestal are divided into six, the uppermost of which is for the height of the entablature of each order; and the remaining five, in the Ionic, are divided into nine, and one is for the inferior diameter; but in the Composite and Corinthian these five parts are divided into ten, and one is assigned for the lower diameter of each column.

In every order the plinth of the pedestal and its cornice are equal in projection; that is, one perpendicular line serves to determine the projection of both.

In every order, without exception, the base of each column is thirty minutes, or half a diameter, high; and, in the Tuscan, Doric, and Ionic, the height of the capitals is the same; but in the Composite and Corinthian their capitals are each of them seventy minutes.

In every order the projection of the base at the bottom of the shaft is ten minutes; or, which is the same thing, the diameter of each shaft being divided into six, one of them is set forward for the projection of the base.

In every order its quantity of diminution may be the same, which is ten minutes; but in my examples the Tuscan and Doric are rather more.

Lastly, all the orders, except the Doric, have their cornices to project as much as they rise; but in the Doric the cornice projects one quarter part more than it rises.

These remarks, if retained in the memory, may help to facilitate the trouble which necessarily attends in drawing the five orders. Besides, it is sometimes required of a workman to give some answer to his employer respecting the general proportions of the orders; and, if he is not acquainted with as much of them as I have briefly laid down in the above observations, he must of course look very foolish in the eye of his querist, for he cannot then have recourse to his book. But further, a workman who has professedly gone through the five orders, by drawing them under the direction of some master, cuts but a poor figure in a conversation on the subject of architecture and proportion, when perhaps, after all, he is unable to recollect one single particular respecting them.

*Of the general Proportions of Frontispieces adapted to the
Five Orders.*

THE Tuscan frontispiece allows six diameters from center to center of each column or pilaster, as described in Plate V. and page 88.

The Doric allows six and a quarter, or one third. The Ionic six and a half; some make it seven and a quarter. The Composite seven; some allow seven and a quarter. And the Corinthian seven diameters and thirty-five minutes; or, as some have it, eight diameters.

These different intercolumniations are nearly proportioned to the strength or delicacy of each order, so that the aperture, or opening for the door of each frontispiece, is much the same in all the orders. For though the Tuscan order only allows six diameters, yet six of these are equal to six and an half diameters of the Doric column. And the Corinthian, though it allows at least seven diameters for its intercolumniation, the opening for the door-way will not, at that rate, be quite equal to six diameters of the Tuscan column,

This sufficiently accounts for the different number of diameters assigned by architects for the door-ways or intercolumns of the frontispieces adapted to each order.

The proportion of doors is generally in height twice their breadth; but, in some cases, a little more height is requisite.

The width of the door is divided into four equal parts; one of which is for the diameter of the column, or breadth of the pilaster. Half a diameter is added to each side of the column, for the impost or ground which receives the projections of the plinth and capital.

Half a diameter is also allowed above the door to the under-side of the architrave, and one for the sub-plinth, or the square part on which the base rests. According to this proportion, from the top of the sub-plinth to the top of the column there will be seven diameters and an half; which will be within half a diameter of the full size of the Doric column, according to the order; but if there be a step up to the entrance of the door, this will increase the column to its full height, which is eight diameters.

To the height of the column must be added two diameters for the whole entablature above the capital: and for every other particular respecting the mouldings, the reader must have recourse to the orders themselves.

General Directions for drawing the Five Orders in Indian Ink.

It is best to procure wove paper, because its substance will bear a better shade, and its quality gives a more handsome appearance to a drawing, than the more common sort. The paper should be regularly damped, and pasted round the edges, so that when it dries it will become tight and even in its surface.

Proceed then to draw a perpendicular line for the axis of the column, and on this line place the several heights required. Through each of these heights draw, by the pencil, lines at pleasure parallel to the base.

Next find the inferior diameter of the column, and afterwards the superior one. From the extremities of the superior diameter draw perpendicular lines upwards, and from the extreme points of the inferior diameter draw perpendicular lines downwards to the top of the pedestal. From these lines place the projection of the base, and from the projection of the base each way, draw two other perpendicular lines down to the base of the plinth.

Thus

Thus far the drawing is prepared for laying on the projections of the several members which take their spring from the above perpendicular lines, and when the mouldings are all drawn by the pencil, the strokes of the pencil should be tendered or made fainter by the Indian rubber, so that the strokes of ink may be more clearly seen as they are drawn, and so prevented from being too strong, which if they are, the drawing is totally spoiled.

If the drawing be on a large scale, as those detached in the plates, the compasses may be successfully applied in drawing the curved members; but if they are small, like the finished and entire orders in those plates, they must be drawn by a fine pointed camel's hair pencil, guided by a steady hand.

The application of any kind of writing ink to the outlines of the drawing must always be avoided, because it neither agrees with the nature or colour of Indian ink. The writing ink not only makes an outline too harsh in appearance, but likewise destroys the effect of the Indian ink; because the water that is mixed with the Indian extracts the quality of the writing ink, and of course they blend together in one mass, and the shadow becomes partly blue and partly black, which destroys the harmony of the whole. Therefore mix good Indian ink by rubbing it on a marble stone, and let the ink stand a few hours,

till the groffer particles settle to the bottom. Add a little water to a part of it, to make a light shade with; and with this light kind mark the outlines of the column, applying the hair pencil to the curved parts, and the brads pen to those which are straight.

After this process rub the drawing quite clean; and observe this as a general maxim, that the fainter the outline the better, provided it can just be discerned.

The next things to be considered are light and shadow, which are opposite in themselves; but if disconnected, no good effect can be produced in a drawing. Wherefore, where a strong light is supposed, there must also be a strong shadow agreeing with it; and where the light is weak, the shadow is less dark in proportion to it.

Rays of light do not project shadows contrary ways at the same time. Therefore the point of light must be fixed in the mind at least, if not on the paper, from whence the rays are directed in parallel lines to the object, which produce a shadow on the contrary side to that which the light comes from. Proceed then to lay on a weak tint on that side of the shaft which is opposite the light; and the breadth of this tint must be proportioned according as the light is supposed to come, either directly

rectly on the front of the picture, or obliquely to it. If the light comes on the front, the tint is narrow; but if obliquely on the picture, the tint is broader, or comes farther on to the center of the shaft in proportion to the degree of obliquity. After having laid on the first tint according to these principles, a second tint must be applied in darker Indian ink; but the dark tint must not be carried plump to the outline of the dark side, because that would destroy roundness; for, in nature, all round or cylindrical bodies have a reflected light; but this reflected light is not equal in strength to the direct light, wherefore the first or weak tint of Indian ink is supposed to be equal in degree to the reflected light, consequently a small portion of the first tint is left on the edge of the shaft, which is graduated or softened into the second tint, which is strong, producing a mass of shade, blending itself in regular gradation with the first tint towards the center of the shaft. After the second tint is perfectly dry, a third still stronger should be applied, in order to complete a high-finished drawing; but care must be taken to lay it on about the center of the second tint, and not broad, but plump, softened a little off at the edges, which will produce a sufficient roundness, if rightly managed.

If the shaft is represented as fluted, its shading will yet require more management; but the same principles must be observed. In managing the flutes, it will be proper to mark their boundaries

boundaries first with a nice brads drawing-pen, filled with thin Indian ink, that it may distribute and pass easily through the pen, leaving a very faint line on the light side, scarcely to be seen; but in ruling the dark side the ink must be laid on stronger, that the outline of the flutes may not be totally lost when the shade is laid on. After the first tint of shade is applied, it will be requisite then to touch in the dark sides of the flutes. Those on the dark side of the shaft may be done by the hair pencil; but if the drawing is on a small scale, the brads pen will do much better on the light side; because, by drawing parallel lines with that instrument in imitation of graving strokes, it will produce a shade in the flute more consonant, and in better tone with the light side of the shaft, than can be performed by the hair pencil.

The flutes on the dark side of the shaft must not be all black, for their concavity will reflect a dim light opposite to their dark side, upon the same principles by which light is reflected on convex surfaces. Lastly, when the flutings are thus handled, a second tint of Indian ink must be laid on at the dark side, by which the flutes and fillets must be made to harmonize, and appear in one mass of shade, without destroying their distinction. In general, the second tint is strong enough for fluted shafts, because the outlines for the flutes contribute towards a shade themselves.

The mouldings must next be considered: and as these are in a different position from the shaft, consequently the light must strike them differently.

In the examples given, I have supposed the aperture, or point of light, above the top of the column; which is a situation highly advantageous to the drawing, because, upon this principle, there will be a regular strong shadow under each covering member productive of a good effect.

Hence, in the Ionic, for instance, the hollow, or upper part of the cyma-recta, has a strong shade; and the swelling part is light in the center, bearing a shade downwards as it recedes back. The corona is also light, because the rays come full upon it; but the cyma-reversa, dentils, and ovolo, are all in shadow, on account of the large projection of the corona, which screens them from the light. The left hand volute projects a shadow on the shaft, and the curved top of each flute does the same. The lower ends of the flutes are light, for the rays come full upon them; but the upper part of the scotia in the base bears a strong shade, because it is totally covered by the projection of the upper astragal.

The cornice of the pedestal is nearly all in shadow; but the

base is nearly all light, for there is nothing to prevent the rays falling upon almost every part of it.

These observations, with the exercise of a little taste and good sense, will, I presume, enable the learner to accomplish his attempt to shade the five orders in such a manner as will do him credit.

END OF THE FIRST PART.

PART

THE
CABINET-MAKER AND UPHOLSTERER'S
DRAWING-BOOK.

PART II.

ON PRACTICAL PERSPECTIVE APPLIED TO THE ART OF REPRESENTING ALL KINDS OF FURNITURE IN DIFFERENT SITUATIONS: COMPREHENDING A REGULAR AND FAMILIAR TREATISE ON THIS USEFUL SCIENCE, DIGESTED AGREEABLY TO THE AUTHOR'S OWN EXPERIENCE IN THE ART FROM SOME YEARS PRACTICE, AND FROM OBSERVATIONS ON THE PRINCIPAL WRITERS ON THE SUBJECT; VIZ. DR. BROOK TAYLOR, DR. PRIESTLEY, MALTON, KIRBY, NOBLE, AND SOME OTHERS.

INTRODUCTION.

THAT the knowledge of perspective is highly useful to Cabinet-makers, Upholsterers, Chair-makers, Joiners, and other persons concerned with designing, cannot be disputed on good grounds. And, though this is an indubitable position, yet many in the above professions are not sufficiently, if at all, acquainted with it. This defect in their education, or neglect in their own application, necessarily subjects such to considerable

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disadvantages,

disadvantages, both with respect to giving and receiving orders. A master cannot possibly convey to the workmen so just an idea of a piece of furniture by a verbal description, as may be done by a good sketch, proportioned according to the laws of perspective, and situated so as to give the most general and clear view of the whole piece. Nor, on the other hand, can a workman so well understand the meaning of a drawing, and what it is intended to represent, without some knowledge of the art I am pleading for; and consequently his progress in executing the work will be proportionably retarded, and, perhaps, not so exactly finished at last. On these accounts it is a master's interest to know perspective himself, and to have men about him that understand it. When this is the case, time is often gained, stuff spared, and disgrace avoided; since it is matter of fact, that many alterations in pieces of work of every kind take place; sometimes owing to bad sketches or drawings, and sometimes from want of understanding a good design when it is given to work by. There are some masters, indeed, who will scarcely allow their foremen time to make any kind of sketch; but, if I may offer my opinion on this head, I must say that such a method of carrying on business neither reflects honour on the foreman, nor in the end turns out to any advantage to the master; but, on the other hand, frequently a considerable loss.

Besides,

Besides, as it is the present mode to introduce much painting in furniture, it is of great use to know perspective, in order to understand when such painting has its proper effect, and to enable the director of work, whether master or foreman, to point out such improprieties as may escape the notice of the painter; and which, if entirely overlooked, might prove injurious to the work, and offensive to a customer of taste.

To these we may mention another advantage that often arises to a master from knowing this art; since, by it, he may often fix the judgment and mind of a gentleman or lady respecting the piece of furniture they wish for, by producing either a drawing that has been previously made, or by being able, off hand, to furnish their ideas with a good pencil sketch. In short, a good perspective drawing may be sent to a gentleman or lady in the country, with almost as much confidence of success as if a model of the piece of work were sent.

Lastly, if the reader consider himself a gentleman, or as possessed of a liberal education, and at the same time entirely unacquainted with this fine art, it will carry in it an air of contradiction; because perspective is founded on geometrical and optical reasoning, and has therefore always been considered as a branch of the mathematics and of a liberal education. Yet it is my intention not to treat the subject mathematically,

because many have done it already in such a manner as far exceeds any thing I can pretend to ; and because it would not suit workmen, for whom the following treatise is intended. If, however, any other above this sphere can reap any information from it on account of its simplicity, I shall be happy to have served them ; but if he be above receiving instruction through that channel or medium which is only intended to convey the knowledge of this art to workmen, the reader may consult some of those authors referred to in the title, where he will see problems, theorems, demonstrations, and corollaries enough to fill his leisure hours with, and to carry the science to any length he pleases. However, to look into some of these books would greatly discourage many workmen, and even some others of a higher class, who dislike the drudgery of perusing and comparing an infinite number of references to a variety of schemes, which are rather more calculated to shew how far the subject may be carried by mathematical skill, than to inform the reader of such principles as may be wanted in the practice of the art, or to give him a tolerable view of the theory on which the science is founded.

And it may be assigned as one reason why the subject of perspective is so little known amongst workmen, that it has been treated too mathematically. For, though geometry must assist in stating theories, and in making new and additional discoveries

coveries of the principles of the art, yet we must not infer from hence that a workman cannot learn the practice of the art without being acquainted with that science.

Malton says the same thing in the preface to his Treatise on Perspective. " Perhaps," he observes, " the demonstrations of the last (meaning the last theorem of his fourth section) may deter those who are not geometricians from examining it with that attention it requires; let such remember, that, in order to practise perspective, it is not absolutely necessary to be a geometrician, because I practised it long before I understood geometry."

In fine, I shall only say, that it has been my aim to put into the hand of the ingenious workman such a view of the subject of perspective, applied to as general a variety of cases, as may enable him to get through with designing any thing he meets with in the course of his business: and if any thing more than this be found in this treatise, the reader will see more than what is promised; which may probably incline him to acquiesce with the author's sentiment, that it is better to do more than we say, than fall short of what we have promised.

SECTION I.

Of the Principles on which Perspective is founded, and the Definitions of those Terms necessarily used on the Subject.

THE principles on which the art is built are founded on the nature of our sight, which invariably comprehends all objects under some angle of a less or greater degree, in proportion as the object is at a greater or less distance from the eye of the spectator.

Hence let A, Fig. 1. Plate XIV. be considered the human eye, which is nearly globular; and P the pupil *, or that extremely small point of the eye into which the rays of light issuing from every part of illumined objects in right-lined directions all converge.

* The term *pupil*, in general, means a youth or minor under the tuition and management of a master or guardian, but why it has been introduced into optics, and applied to the aperture or small opening of the eye which receives the light, is owing to the little image—or *pupilla*, a puppet—which is reflected in the eye, and seen by every one who looks steadily on it, which is no other than the spectator himself, whose image in miniature is reflected on the crystalline humour.

Thus

Thus the rays BP and DP, issuing from the serpentine figure BD, are said to converge, because they unite in a point at P, the pupil; and, after passing through the pupil and continuing in their direct course, they diverge or spread open as at *n m r q v t*, on that part of the eye called the retina*, by which an object is formed similar to the originals BD, EC, FG, and in magnitude according to their different distances from the eye†. Therefore, as the first object BD is nearest to the pupil P, the points *nt* on the retina are most extended, because the angle DPB, under which the object BD is seen, is considerably larger than those under which the objects EC and FG are seen.

And again, as the same object is removed back to EC, the rays are less extended on the retina as at *mv*; but if the object be removed still further from the sight P to FG, the rays will still diverge less, and consequently the object painted on the retina will be proportionably smaller as at *rq*. And thus, by removing the object FC still further and further from the sight, it would be seen under a proportionably smaller angle, until

* Retina, from *rete*, a net; because this part of the eye is a fine expanded membrane, somewhat open like a net, and spread over the bottom of the eye, on which are painted the pictures of all the objects we perceive.

† The refraction of the rays of light occasioned by their passing through the different mediums or humours of the eye, has nothing to do with perspective, it belongs to optics only, on which Ferguson's Lectures may be consulted, and others on the subject.

it would at length vanish into a point, and lose its appearance.

That the rays of light, by which we are made sensible of objects, make their way to the organs of sight in right-lined directions, is evident from a most simple experiment: for, if the bore of a tube or pipe be as much curved as is equal to the diameter of the bore, nothing can be seen through it; or if one object standing before another of equal magnitude on the same line, be viewed by a person standing on that line, the last will be hid, provided they both stand upright. I simply mean, if the shafts of two columns of equal diameters were placed upright, and a spectator were standing upright on a line passing through the centers of each shaft, the last one could not be seen; but if vision, or the faculty of seeing, were performed by rays of light in curved directions, perhaps this would alter the case, but not for the better, as I am certain that the construction of our eye, and the way in which we, at present, discover objects, are the perfect productions of Infinite Wisdom.

From what has been said and referred to in the figure, I presume that the reader is not altogether ignorant of these two things: first, that all objects appear to the spectator proportionably less the further they are removed from the eye; and, second, that the rays of light coming from every part of il-

lumined objects operate on the eye in right-lined directions. These two propositions being admitted as certain truths, two very considerable points in perspective will hereby be gained. First, that in the representations of objects originally of the same dimensions, those which are furthest from the front of the picture must be least, in proportion to the supposed or real distance of the spectator's eye from the object: and second, that a right line from the top and bottom of the front objects, terminating in a point on the horizon, will determine the heights of all those back objects which are originally of an equal height with those on the front.

Hence, if a range of columns be represented on a picture, a right-line from the top and bottom of the first column to some point in the picture, will determine the heights of all those behind. Experience will convince us of the truth of this: for if we place ourselves at a distance from a straight row of columns, standing a little to one side, and looking attentively from the first to the last column, we shall then see that the pillars will appear to diminish backward in the form of a triangle; or, in other words, the tops and bottoms of each column will seem to tend to one point.

The same may be observed by standing close to a long brick wall, and ranging the eye along the joints of the bricks; we

shall see each joint seemingly terminating into one point. Those joints below the eye will appear to rise up, and those above it will seem to lower; and if the length of the wall were continued as far as we could see, the joints would apparently unite in one point.

These simple experiments cannot be accounted for upon any other principle than that which I have already advanced on the nature of vision; namely, that all objects, as they recede from the eye, are seen under a smaller angle in proportion to the distance of the object from the eye. This proposition holds good, not only as it relates to the heights of objects, but also to their breadth and thickness, for these are diminished or contracted by the same rules, founded on the nature of our sight. Nor are these remarks to be restricted to such objects as stand upright on the ground, for those which are horizontal in their position, or which are lying in various situations on the ground, are all subject to the same laws of diminution. But it must here be observed, that the various positions of objects give birth to most of those imaginary planes which are introduced into the subject of perspective; for in these planes all the variety of objects that we can conceive of, are supposed to be situated, some in the ground-plane, and others parallel to it, both above and below the horizon; some in upright, and some in oblique or inclining planes. And this variety of planes should be understood

stood and carefully distinguished by the learner, before he can make any good progress in the art, or know what he is about, when he begins to represent.

These planes are again bounded by so many right lines, of which they are composed; and these lines have their names, answering to their intended use in the practice of perspective.

Since, therefore, planes, lines, and points, comprehend the whole art of perspective, it will be requisite to define these in as clear a manner as possible. The reader will, perhaps, imagine here, that I am drawing him into the study of geometry, as an essential requisite to the practice of perspective, and thereby contradicting what I have already advanced in the preface. If, indeed, to exercise our reasoning faculties, and to make use of a little common sense, be termed the study or knowledge of geometry, I will aver that no man will ever learn perspective without these. But, this every one knows; that many can exercise both good sense and reason who never saw nor heard of Euclid.

Besides, if the reader has attended to the first part of this work, in which lines, superficies, and solids, have been touched on in a general way, he cannot be considered as totally ignorant

of some part of geometry which is useful to the knowledge of perspective; however, as I have said nothing of planes and their intersections, I shall here explain them, so far as they relate to the subject of perspective.

Of the Nature of Planes relative to the Subject of Perspective.

A plane, strictly speaking, is an even surface, neither concave nor convex, but which will agree with a straight ruler or line every where.

A plane, in theory, may be considered indefinitely, or definitely. When it is supposed to be indefinite, it admits of no bounding lines, but is imagined to be continued without limits.

When it is defined, its boundaries are limited by lines, as A B, B O, O D, and D A. Fig. 2.

In perspective there are five planes principally in use, according to Dr. Brook Taylor's system; but the various circumstances of objects in the picture frequently produce a variety of others, which, however, are not termed the elementary planes, as the above five may, but only accidental, depending on the circumstances of objects.

Of the Ground Plane.

IN the order of these planes I shall consider the ground plane first, being commonly a horizontal surface on which original objects have, in general, their seats or foundations; as 1, 2, 3, 8, is the seat of the case of drawers on the ground plane AB, DO, Fig. 2.

The Doctor terms the ground plane the original plane, "By which," he says, "we mean the plane wherein is situated any original point, line, or plain figure." I shall, in general, however, use the term ground plane, as being more simple, except in cases where no regard is paid to its being horizontal; then, indeed, the term original plane must be used, being more comprehensive, as it includes any position.

Of the Perspective Plane.

SECOND, the perspective plane, otherwise called the plane of the picture; which, in general, is a plane perpendicular to that of the ground, as GR, HL.

This plane is to perspective what the retina is to optics; for the images of all original objects are delineated on both.

The

The perspective plane may be considered as some transparent medium placed upright between the object we view and our eye; and as the rays of light coming from every point of illuminated objects converge, in right-lined directions, to a point on the pupil P, Fig. 2, a section of those rays, produced by this transparent medium or perspective plane, is the perspective representation of the original object, be it what it may.

Hence, let the learner place himself before a glass window, which is, properly speaking, the perspective plane to every object he looks at through it; and as those objects appear to him on the window, such is their perspective representations on the paper, board, or canvass, we draw on. The appearance of objects on a window may be found by gumming the glass, which does not destroy its transparency, but makes it capable of receiving a mark; and if the eye be kept perfectly steady to one point in the window, and, with a pencil, the points or angles of a house, for instance, be marked as they appear on the glass; and when this is done, if right lines be drawn to each point, these lines will form the perspective of the house.

Thus the plane GR, HL, may be considered a piece of gummed glass fixed upright on a table or ground AB, DO; and at P is the spectator's eye, viewing through the glass the original object 1, 3, 5, 7. The right lines issuing from every part of the object and converging at P, represent the rays of

light passing through the transparent medium to the eye P. Now, as the original object is described on the glass by the direction of these rays, if the spectator, with his hand, mark the points 1, 3—5, 7, 4—6, and afterwards join the points by right lines, this will be the exact perspective representation of the original object.

Simple experiments of this sort should be practised, as I am persuaded they are more calculated to teach the principles of the art than long and tedious theories *.

Of the Horizontal Plane.

THE horizontal plane, or plane of the horizon, is, in perspective, an imaginary plane passing through the eye of the

* An artist lately informed me, that a piece of ground glass, unpolished, and oiled over with sweet oil, is the best for this purpose; for the oil gives a degree of transparency to the glass that admits of objects being seen through it, and its artificial roughness makes it easy to draw on. If a square of glass of this sort be put in a slight frame of wood, fixed upright on a plain board, and there be a sight-hole made in a piece of wood fixed perpendicular to the square of glass; and if the sight-hole be fixed from the glass equal to the distance P s, and to the height of the eye P N, then every thing which relates to Fig. 2, may be proved by ocular demonstration, provided the learner use this little instrument according to the references made to this figure in the different heads of this section.

spectator,

spectator, and being perfectly parallel with the ground plane, it cuts the upright picture or perspective plane at right angles.

Thus, in Fig. 2, Plate XIV. FH, LM, is the horizontal plane, whose perpendicular height from the ground plane A B O D is the height of the eye at P; hence PN is the perpendicular height of the eye, because the line PN is perpendicular to both these planes.

The horizontal plane FH, LM, being produced, it necessarily cuts the perspective plane GH, LR, at right angles, and the intersection of these two even surfaces or planes with each other being a right line as HL; hence we have what is commonly called the horizontal line HL; or, more properly, the vanishing line of a plane parallel with its original. And as the intersection of the horizontal with the perspective plane produces the vanishing line HL, so the intersection of the picture with the ground plane produces the base or ground line GR..

All original objects, as they appear to come into the plane of the horizon, gradually vanish into a point, and disappear. Hence the application and use of the term horizon in perspective, which literally means the limits or boundaries of our sight, from “*οριζων, borizo*, I limit or bound.” The further objects are represented from the front of the picture, or from the
ground

ground line GR, the nearer is their approach to this plane, and consequently their apparent magnitude will be proportionably less, as has been already demonstrated in page 183. For if the case of drawers, in Fig. 2. were removed considerably further from the perspective plane GRHL, it is evident that the rays 1 P, 3 P, 5 P, 7 P, &c. would not subtend * so large an angle on the plane of the picture as they do at present: it is also manifest that these rays will also rise higher on the picture in proportion as the case of drawers or original object is removed back, consequently the image 1, 3, 5, 7, of the drawers on the picture would approach nearer to the horizontal plane, until at length the image on the picture would totally vanish at s, the center of the picture and height of the eye.

To understand this yet more clearly; suppose the drawers to be brought forward close to the picture, then the foot 1 would be at 10, and the foot 3 at 12, on the intersection or ground line GR, and the image of the original object would then appear as large on the picture as the original itself; for then the point 5 on the drawers would be at *a* on the picture, and the point 7 at *b*; but the whole image of the original, in this case, is lower on the picture than before, and consequently farther from the horizontal plane, which was to be shewn.

* From *sub* and *tendo*, I stretch. The subtense of an angle coincides with the chord of the arch. Thus the object BD, Fig. 1, subtends an angle of 60°, for the rays BP DP cut the arch in that proportion, and therefore the object BD is said to be seen under an angle of 60°.

From what has been said, it is obvious that the whole space on the plane of the picture for delineating objects, is comprehended between the ground line G R and the horizontal or vanishing line H L. No object can with propriety have its seat on the picture below the line G R, for this line is the intersection of the ground plane with the plane of the picture; and therefore, to represent the case of drawers lower than at 10 and 12 on the ground line G R, would lead us to suppose a new ground plane below the first, and a new horizon to suit it, otherwise the drawing would be unnatural and distorted.

On the other hand, no original object can have its seat in the perspective plane higher than H L, for the line H L marks out the intersection of the horizontal with the perspective plane; and as the plane of the horizon is generally the vanishing plane of all original objects situated on the ground, their seats in the picture cannot be above the vanishing line H L, without producing worse effects than in the other case just mentioned. For if the images of all original objects, however large, vanish into a point *s* in the vanishing line H L, it would be preposterous to see a tall object seated on this line, or above it.

Before I quit this head, it will be proper to observe, that the horizontal plane, on which I have seemingly laid so much stress, does not possess any thing peculiar to itself, owing

to its being considered a plane, perfectly level; for all the various positions of vanishing planes make no difference in theory, provided they are considered as parallels to original planes. It is the position that these planes have to each other that is to be regarded. This was one principal discovery which Dr. Brook Taylor made in his new system of perspective, and which has rendered his principles so universal. In his book he says, "He makes no difference between the plane of the horizon and any other plane whatsoever; for since planes, as planes, are alike in geometry, it is most proper to consider them as so, and to explain their properties in general, leaving the artist himself to apply them." Yet it may be observed, that we have a natural prejudice in favour of something peculiar to the horizontal vanishing plane; because, in nature, the laws of gravity settle all solid bodies in a horizontal position: this being the case, we are accustomed to view objects in this form, and of course are required to draw them so; therefore, in the practice of perspective, the horizontal vanishing plane is generally wanted; but in principle and theory, the relation that one plane has to another is only to be regarded.

Of the Directing Plane.

THE directing plane is imagined to be parallel with the picture, whatever position it is supposed to be in; and its distance from the plane of the picture is equal to the distance of the eye of the spectator; therefore it is considered as a plane passing through the eye, as the plane MFVU, Fig. 2. Hence, if any original line ZX be produced till it cut the directing plane MFVU, a line drawn from Y, where it intersects, to P, the place of the eye is termed the directing line of that original line ZX.

And the representation of any original line in the plane of the picture is always parallel with its directing line in the directing plane.

Of the Vertical Plane.

IN perspective, the vertical plane is considered as perpendicular both to the ground plane and the plane of the picture; consequently it cuts the other four at right angles. The plane
 PsQN,

$P\mathfrak{s}QN$, Fig. 2, is thus termed geometrically, because it is in a direction perpendicular to the horizon; but in perspective it may be in any position, provided it be perpendicular to the original and perspective planes, and at right angles with the other.

The intersection of this plane with the picture $HLGR$ produces the perpendicular line $\mathfrak{s}Q$, termed the vertical line of the picture; and the vertical plane being continued till it cut the directing plane in the line PN , that line PN is the intersection of the vertical with the directing plane; and as $\mathfrak{s}Q$, the vertical line of the picture, is parallel with PN the intersection of the vertical with the directing plane: PN is therefore the directing line of $\mathfrak{s}Q$, the vertical line of the picture.

Vertical planes have vertical vanishing lines when the picture is perpendicular to the ground plane; in which case the vertical line $\mathfrak{s}Q$ is continued to a length above and below the horizon HL , that will admit the necessary vanishing points.

Of the Visual Plane.

To these planes already described may be added the radial or visual planes.

A visual or radial plane, is such as passes through the eye, and any original line whatever.

A plane may be continued by any three points. The three points PXY are the intersections of three right lines; and, according to geometrical reasoning, when three such lines meet each other, as the lines PX , XY , and YP , they are all in the same plane. This, among geometricians, is an axiom or self-evident truth, and therefore needs no demonstration.

The continuation of the plane $PCYX$, which the triangle YPX is in, till it intersects with the plane of the picture, is therefore the visual or radial plane of the original line ZX ; and the line $v16$, produced by the intersection of the visual plane with the plane of the picture, is termed the visual line of the original ZX .

As I have already observed and proved that the appearance of objects on the retina is conveyed by rays of light flowing

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ing from every point of any object to the eye in right-lined directions, see page 184; let the right lines XP , ZP , be considered as the rays of light coming from the original object ZX , and converging at P ; but these rays are cut or intersected by the plane of the picture $GRHL$ at xz , therefore the line xz is the projection of the original object ZX on the plane of the picture; or, in other words, it is the perspective representation of the original object ZX : for the representation xz of the original line ZX is in the line $v16$, which is the intersection of the visual plane $PCYX$ with the plane of the picture: and since the line PC is the parallel of the original line YX , where PC cuts the plane of the picture at v , proves that the line $v16$ is the true line of intersection produced by the visual plane cutting the plane of the picture. Hence the line $v16$ is, in perspective, termed the visual line, from *visio*, I see; for the lines PZ , PX , are the rays of light by which vision is performed, or by which we perceive objects, and as the intersection of those rays is in the line $v16$, so this line $v16$, drawn on the picture, is properly termed the visual line of its original ZX .

Of the Lines in Perspective generated or produced by the foregoing Planes.

I HAVE already spoken of these lines in the explanation of the several planes to which they are related; but it will also be requisite to sum them up here, that the learner may have a more clear view of them from what has been said.

First.—The ground line GR, is a line produced by the intersection of the picture or perspective plane H L G R with the original plane A B D O. It may also be simply termed the intersection of the picture; but some choose to call it the entering line.

Second.—The vanishing line H L, commonly called the horizontal line, is produced by the intersection of the vanishing plane F H M L with the plane of the picture H L G R.

Third.—The parallel of the eye F M, is a line produced by the intersection of the vanishing plane with the directing plane U V F M; and as this line is the intersection of a plane passing through the eye always parallel to the picture, consequently

F M

FM is always parallel to the vanishing line HL, and of equal height to it.

Fourth.—The directing line UV is the intersection of any original plane ABDO with the directing plane UVFM.

Fifth.—The vertical line Qs passing through the center of the picture s, is the intersection of the verticle or upright plane PN sQ with the plane of the picture; and PN, the perpendicular height of the eye, is the intersection of the vertical with the directing plane.

Sixth.—The visual line v rG, is produced by the intersection of the visual plane PYCX with the plane of the picture, and is therefore the indefinite representation of the original ZX.

Seventh.—The director of an original line. If any original ZX be produced till it cut the directing plane UVFM, a line PY is termed the director of that original line ZX.

Eighth.—The radial line*, or parallel of any original line ZX. In whatever degree of obliquity the original line ZX intersects the ground line GR, in the same degree of inclination

* Radial, from *radus*, *rados*, or *radius*, a ray of light.

will the radial Pv cut the vanishing line HL ; for Pv is parallel to the original line ZX .

Of Points, in Perspective, produced by the Intersections of the preceding Lines.

As the intersections of planes with each other generate or produce lines, so also lines meeting or cutting each other produce points.

Hence the following points in perspective are produced by the intersections of the lines which we have now defined.

First, the point of sight, or the place of the eye; P is that point where the spectator's eye ought to be placed in viewing the picture. Hence, if through the eye P a line perpendicular to the original plane be produced till it cut the parallel of the eye FM , their point of intersection is the point of sight P .

Second, the center of the picture. If from the point of sight P a line be drawn perpendicular to the picture, and be produced till it cut the vanishing line HL , their intersection will be the point s , or that point termed the center of the picture;

ture; and the distance between the point of sight P , and s , the center of the picture, is called the distance of the picture; and the line itself which measures this distance, may be termed the direct radial.

Third, the vanishing point. If, from the point of sight P , a line be drawn parallel to any original ZX , and is produced till it cut the vanishing line HL , their point of intersection v is the vanishing point of the original line ZX ; because, if the original line ZX were infinitely produced on the ground plane $ABDO$, its image ZX on the picture would at length vanish or disappear to the eye P in the point v . The line which measures the distance between v and P , is the distance of that vanishing point v ; and the line itself may be termed the oblique radial, because its original ZX is oblique to the picture.

Fourth, the point of intersection. If the original line ZX be produced till it cut the ground line GR , that point 16 where the line GR is cut, is called the point of intersection: and if the original line ZX be still continued till it cut the directing line UV , the point Y , where they intersect, is termed the direct-point of that original ZX .

Lastly, The point of station. If from the place of the eye P , a line be drawn perpendicular to the ground plane

at N, that point N is the point of station, or foot of the spectator.

I shall conclude this section with advising the reader to make himself well acquainted with the preceding planes, lines, and points, before he proceed further: which, if he do, it will enable him to read the subsequent pages more easily, and often prevent the trouble of referring to the plates. Add to this, it will make him understand more readily the problems and operations of both this and other publications on the subject.

SECTION II.

The Affinity and Agreement between Optical Laws and the Principles of Perspective demonstrated—And also of the Use of the three principal Elementary Planes in the Practice of Drawing—showing, that all that is exhibited by the natural Positions of these Planes in Fig. 2, may be correctly drawn on any even Surface without their Aid.—Of the various Positions of Lines and Planes to the Picture, and of the Principles of Vanishing Points agreeing therewith.

Of the Affinity of Optical Laws with the Principles of Perspective.

IN Section I. page 183, it has been shown that all objects appear proportionably less as they are farther removed from the eye; and as the reader is now supposed to be acquainted with the planes, lines, points, and terms, which have been explained in the preceding section, I shall proceed to show that the rules of perspective agree with optical laws.

Thus:

Thus: let GR , Fig. 4, be the ground line, and HL the horizontal or vanishing line, whose height above the ground line is equal to that of the eye of the spectator; s is the center of the picture, and sD the distance of the spectator's eye from the object bd . Draw $d'b$ perpendicular and equal to BD , Fig. 1, and as much to the right hand of s as D , in Fig. 1, is to e . Then, in Fig. 4, draw the visual lines ds and bs ; which lines are to determine the heights of the two original objects, EC , FG , in Fig. 1. Then take the spaces DC , CG , from Fig. 1, and transfer them to Fig. 4, from a to a , and from a to n , on the ground line GR . Draw the lines a, D, nD , cutting the visual line ds in gc ; and lastly, from g and e on the visual sd , raise perpendiculars to sb ; then will g, f, c, e be the perspective representations of GF and CB in Fig. 1.

The analogy between the two figures will appear as follows.—In optics, P , in Fig. 1, is the pupil, and Pe the direct radial or axis of the eye, and equal to the distance of the first object DB from the eye. In perspective, D , in Fig. 4, is the same as P in optics, Fig. 1; and, in Fig. 4, s , the center of the picture in perspective, is the same as e in Fig. 1. Therefore as Pe in optics is the direct ray, and the distance of the first object DB from the pupil P , so sD , Fig. 4, in perspective, is the distance of the spectator's eye from the picture. In optics, if the second object CE is removed twice as far from the eye P as the first

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object

object DB is, its image mv , on the retina, will be little more than half the length of the image tn of the first object DB on the retina; and, in perspective, Fig. 4, the representation ce of the second object CE, is exactly half the length of the first object DB, as Fig. 4 demonstrates, and which coincides with Fig. 1; for observe, the rays of light PE, PC, coming from the second object to the pupil P, cut DB, their section, in the same proportion as the visual lines sd, sb , of Fig. 4, cut the perpendicular ce . Hence the space 2, 7, on DB, is equal to the representation cc , Fig. 4; and in the same manner the space 1, 8, where the rays of light from FG cut the picture DB, is equal to gf , Fig. 4, the representation of GF, Fig. 1.

Lastly, the representations gf, ce , in Fig. 4, approach to the center s , in the same proportion as their originals GF, CE, in Fig. 1, approach to e , the center of the imaginary plane BD, which is supposed to cut the rays of light PC, PG, at 2, 1; for the space D 2 and 1 on Fig. 1, is the same and equal to $d, 2, 1$, on Fig. 4; so also is d, e , Fig. 4, to D e , Fig. 1. And hence it may be concluded, that the rays PC, PG, are to their section D e , Fig. 1, as the visual line ds is to its dividers or measuring-lines D $a, D n$, Fig. 4.

Before I conclude this head, it will be proper to observe, that notwithstanding the general agreement between optical laws

laws and the rules of perspective, yet in one respect there is a difference, for the perspective representation of any object on a plane, is not the same exactly with the appearance of that object to the eye; and therefore, in allusion to this difference, I have, in the preceding page, already said, "In optics, if the second object CE is removed twice as far from the eye P , Fig. 1, as the first object DB is, its image mv on the retina will be little more than half the length of the image tn of the first object DB ; but the representation 2, 7, of CE on a plane DB , which is the section of the rays PC , PE , is only half the length of the first object DB , as the figure itself demonstrates." The reason of this difference is owing to the eye being a sphere, but a picture a level surface or plane; for the rays PC , PD , cut the arch or sphere KL at 6, 5, in a different proportion to what they do on the plane BD , as is plain; because the space $D2$, which is the representation of the space DC on the plane BD , is greater than the space 6, 5, on the sphere KL ; which space 6, 5, is the appearance of the space DC to the eye; but the space $D2$ is its representation on the picture. This difference, however, decreases the further the object is removed from the eye, for then the rays do not cut the picture so obliquely; consequently the representation of the original object on the plane of the picture is more natural, because it has more of the appearance of that real object to the eye. Thus: if the object EC be removed back to FG , the rays PG , PF , are less oblique

oblique to the picture BD ; and therefore the representation 1, 8, on the picture BD , is nearer to its true appearance ob on the arch KL , than the representation 2, 7, is to its true appearance 5, 11, on that arch; but much more does this difference appear between the first object BD and its real appearance $y, 60$, on the arch KL , which yet would be considerably more if P were removed to Z . Hence the necessity of choosing a proper distance for the representations of objects on a picture, that their appearance on the picture may be nearly the same as the real objects have to the eye. This will be touched on in its proper place.

The difference then between the representation of objects on a plane and their appearance to the eye, which is a circle, is as the difference of the tangent of the arch, which comprehends the angle under which the object is seen, is to the subtense of that angle. Thus: let DC be the object viewed at P ; then will 6, 5, on the arch KL , be the opening or subtense of the angle under which the object DC is seen, which measures fourteen degrees; and $D2$, the representation of DC on the plane BD , is the tangent of that arch 6, 5, which comprehends the angle under which DC , the object, is seen.

From what has been said on this subject, it is evident that a perfect picture of objects, as they appear to the human eye, cannot be delineated on a plane. It may be done on the surface of a sphere, when the eye of the spectator is supposed to be in its center; for then every part of the picture would be equidistant from the eye, and every ray of light perpendicular to its own surface, as are the rays yP , II , P , &c. of the sphere KL . None of the rays, in this case, could cut the picture obliquely, and consequently no distortion would appear. But though this be the case, yet it will not afford any solid objection to the certainty of perspective rules adjusted to a plane; for, by the help of light and shadow applied in different degrees of strength to objects as they are more or less remote from the eye, and by a judicious choice of the distance, a picture may be drawn on an even surface, so as to deceive the eye, and produce in the mind similar effects with the original or real objects.

*Of the Use of the three principal * Elementary Planes in the Practice of Drawing—also shewing that every thing exhibited by the natural Positions of these Planes in Fig. 2, may be drawn on an even Surface without their Aid.*

It is not always understood, even by those who have some general notions of perspective, how it is that these planes answer to a level surface, such as the paper we draw on; but, until there be some conception of this, I will venture to say that perspective can never be clearly comprehended. Therefore, that the reader may have a clear view of this matter, I shall refer him to Fig. 5, Plate XV. in which are shewn similar letters and numerals, corresponding with the similar planes, lines, and points of Fig. 2, as follows:

The plane GOBR, Fig. 5, is the original or ground plane GOBR, Fig. 2; also the plane GHLR, Fig. 5, is the perspec-

* Elementary, “from the Latin *elementum*,” the first rudiments or principles of any science. Hence, in perspective, the ground plane, the plane of the picture, and the vanishing plane, are considered as the three chief elementary planes; because the first principles of the art must be derived from them. The vertical, directing, and visual planes, are also termed elementary, as has been shewn in the first section, but not so essential in practice.

tive plane denoted by the similar letters in Fig. 2; and the plane F H L M, Fig. 5, is the vanishing plane F H L M, Fig. 2.

If, in Fig. 2, a line be extended from P to *s*, from *s* to Q, and from Q to U, that line will measure the length of all the three planes⁴ in Fig. 5, as from P to U. Thus the ground plane, the perspective plane, and vanishing plane of Fig. 2, are supposed to be stretched out of their natural position till they become an even surface, as in Fig. 5. The line GR, in Fig. 5, is therefore the intersection of the picture with its original plane, as in Fig. 2; and the line HL, Fig. 5, is the vanishing line, produced by the intersection of the vanishing plane with the plane of the picture, Fig. 2. The line FM, Fig. 5, is the parallel of the eye, denoted by these letters in Fig. 2. And lastly, Q*s*, Fig. 5, is the vertical line Q*s*, Fig. 2, which is produced to P, in Fig. 5; on which is placed the distance P*s* of the spectator's eye from the picture, as P*s*, Fig. 2.

These things being understood, proceed to draw the plan of the case of drawers on the ground plane G O B R. Thus: from Fig. 2, take the space Q T, equal to the distance which the drawers are placed from the picture. Transfer this space to Fig. 5, from Q to *t*, and draw the line 1, 3, parallel to GR; because 1, 3, in Fig. 2, is parallel to the plane of the picture. Ex-

tend the compasses from *r* to *3*, and from *T* to *w*, of Fig. 2, for the length and breadth of the drawers, and make the plan on Fig. 5, the same.

In Fig. 5 produce the line *8, 3*, and *2, 1*, to *G R*, at the points *10* and *12*, answerable to *10* and *12*, Fig. 2. Draw then the visuals *10, s*, *12, s*, Fig. 5, corresponding with *10, s*, *12, s*, Fig. 2, on the plane of the picture. Take then, from Fig. 2, the perpendicular height *T y* of the drawers, and place this from *10* to *b*, and from *12* to *a*, Fig. 5. Draw then the visuals *b s*, *a s*, answerable to the same letters in Fig. 2. Next, from the points *1, 3, 8, 2*, draw lines tending to the point *P*, which will cut the visual lines at *1, 3*, in the same manner as the rays *1, P, 3, P*, cut the visuals *10, s, 12, s*, at *1, 3*, Fig. 2.

In Fig. 5, from *1, 3*, raise the perpendiculars *1, 5, 3, 7*, cutting the visuals *b, s, a, s*, at *7, 5*, in like manner as the rays *5, P, 7, P*, Fig. 2, cut the points *5, 7*, on the plane of the picture. Draw then from *7* to *5*, Fig. 5, a line parallel to *1, 3*, which will determine the height of the drawers; and for the apparent breadth of the top, raise a perpendicular *g, 6*, from *g*, the point where the line *8, P*, cuts the visual *10, s*, and the point *6* will determine the apparent breadth of the drawers; in the same manner as the rays *P, 4, P, 6*, cutting the visuals *a, s, b, s*,

at the points 6, 4, determine the representation of the top of the drawers 5, 7, 6, 4, at the corresponding points on the plane of the picture, Fig. 2.

By these operations it is manifest that the representation of the drawers in Fig. 5, where the planes are stretched out till they become an even surface, is the same in all its parts as the image or representation of the case of drawers on the plane of the picture Fig. 2, where all the planes are in their natural positions. This would follow from a process of geometrical reasoning; but, perhaps, it would be too tedious to the reader, and a deviation from the professed plan of this treatise; and, therefore, I shall only recommend to him, to apply the compasses to each representation in the different figures, by which he will perceive the equality of parts in both; and, if to this be added a little reflection on the preceding operations, I have not the least doubt of its being understood.

Of the various Positions of Lines and Planes to the Picture, and to the Ground Plane—also of their Representation on the Picture agreeing therewith, and of their various Modes of Vanishing.

THE original line Z X, in Fig. 2, is oblique to the picture, and is therefore treated in a diverse manner from the lines in the chest of drawers, which are all either parallel and perpendicular to the picture, or parallel to the ground plane and perpendicular to it.

Case 1.—When any line 1, 3, Fig. 2, is parallel to the picture and to the ground line GR, its representation is parallel also. This is self-evident by inspecting the figure.

Case 2.—Lines in the aforesaid positions can have no vanishing line or point in the picture, because if infinitely produced would never cut it; that is, the lines 1, 3, and GR, Fig. 2, would never meet in a point, however far produced, for lines truly parallel can never cut each other.

Case 3.—The representations of lines originally parallel to each other and to the picture, are parallel to one another
on

on the picture. Thus: the lines 1, 3, 5, 7, 4, 6, Fig. 2, are all parallel to each other and to the picture; therefore their representations 1, 3, 5, 7, 4, 6, on the picture, are all parallel to one another, as is self-evident by comparing these with their corresponding lines in Fig. 5.

Cafe 4.—If any original line 1, 5, Fig. 2, be perpendicular to the ground plane, its representation will be perpendicular to the ground line G R; wherefore the representation of the original 3, 7, or any other in the like position, situated any where on the ground plane, is perpendicular to the ground line G R. Hence the correspondent lines 3, 7, 1, 5, Fig. 5, are drawn perpendicular to G R, the ground line.

From the above theory it may be concluded, that the representation of a geometrical square or parallelogram*, is a geometrical square or parallelogram, if it be situated in a plane parallel to the picture. Hence I K, L M, Fig. 6, is the true representation of the original square A D, B C, which is in this position.

Cafe 5.—All lines perpendicular to the picture, have their vanishing points in the center of the picture.

* See its definition in page 44, and its figure Plate II.

The lines 5, 4, 7, 6, of the ends of the drawers, are perpendicular to the picture H L G R; consequently their representations 5, 4, 7, 6, on the picture, appear to terminate to a point at *s*, the center of the picture. Wherefore, in representing the top of the chest of drawers at Fig. 5, *ba* is made equal to the length 5, 7, Fig. 2; and from *ba*, Fig. 5, lines are drawn to the center *s*.

Hence the representation of a geometrical square, situated in any plane perpendicular to the picture, is a trapezoid, as I K, L M, Fig. 6; that is, two of its sides, I K, M L, are parallel, and the other two, K L, I M, not so*.

In whatever position an original plane may be in with respect to the ground plane, if it be but perpendicular to the picture, the representation of a geometrical square in that plane will still be a trapezoid. If the planes be above or below the horizon, its appearance will be of that figure. Thus, in Fig. 3, *a, b, o, p*, is the representation of a square situated in the ground plane, which is certainly perpendicular to the picture, if the picture be perpendicular to the ground; as N *q*, a section of the picture, is upright to *q b*, one of the sides of the square: *c i* is also the representation of a square, situate in a plane raised above the

* See its definition page 44, and its figure Plate II,

ground plane, but parallel with it, and therefore perpendicular to the picture in this case; also ef is the representation of the same square, situate in the plane of the horizon, which is a plane equal to the height of the eye, as the plane $F M H L$, Fig. 2. Wherefore in this plane the square does not appear, for it vanishes into one right line, as $e 2$. But if thickness be attributed to the square, as denoted by the double line, then, by the help of shadow, two of its sides may be seen, as $e 1$, $1, 2$; but observe, both the sides are in one right line.

The squares $g b$, $l k$, are in planes above the horizon, elevated nearly as much as the other two $a b$, $c i$, are below it; their appearances are therefore trapezoids of nearly the same dimensions. And it is also evident, since all these squares are situate in planes perpendicular to the picture whether above or below the horizon, they must have their vanishing point in the center of the picture s ; and, as they are all parallel to the ground plane, their common vanishing line will be $H L$.

Case 6.—If a geometrical square be situated in a plane inclined in any angle to the ground plane, whether it be above or below the horizon, provided the plane be considered perpendicular to the picture, its representation will be, as before, a trapezoid; and likewise its vanishing point will be in the center of the picture. Thus, in Fig. 8, No. 1, $A D B C$ is the representation of a geometrical square in a plane $A E P O$, inclined to the ground plane

plane equal to the angle nAD . Now it is evident, that the square will incline to any angle, by supposing it to revolve on its center AC in the arch unk ; for the side DB of the square may be pressed to tk or ou , or to any point in these arches, without altering its position to GR , the ground line or section of the picture; therefore, wherever the side of the square DB is in these arches, it will still vanish to s , the center of the picture; and its appearance will be a trapezoid: for uo , DB , kt , are all parallel among themselves, and to rs , which is perpendicular to the picture. For the same reasons the other squares above the horizon, though inclined to the ground in different degrees, and in different directions, have the same vanishing point.

Case 7.—All lines oblique to the picture, but parallel to the ground plane, have their vanishing points somewhere in the horizontal line HL , Fig. 2; but not in the center of the picture, as in Case 6, when the line is perpendicular to the picture. Also if oblique lines are parallel to each other, they all have the same vanishing point. The original line ZX , in Fig. 2, is oblique to the picture, and its vanishing point is at v in the vanishing line HL , not at s , the center of the picture; for a line drawn from the eye P , and produced till it cut the picture at v , in a parallel direction to ZX , is the vanishing point of that original line ZX . Wherefore, in Fig. 5, where the elementary planes are stretched out to an even surface, draw the original

ZX inclined to GR , in the angle which it is supposed to be in to the picture in Fig. 2. Produce XZ till it cut GR at 14 in Fig. 5; then lay the distance of the eye from the picture on the vertical line at P , and from P draw Pv parallel to ZX ; then will v be the true vanishing point to the line ZX , upon the same principles that v , in Fig. 2, is the vanishing point to ZX in that figure.

If a number of lines oblique to the picture be parallel to each other, they will all have the same vanishing point; for the same reason as a number of lines perpendicular to the picture have but one vanishing point in the center. Therefore, in Fig. 9, Plate XVI. the geometrical square 1, 2, 3, 4, having its sides oblique to the picture, the sides which are parallel to each other are drawn to one vanishing point. The sides db, ca , are originally parallel to each other, for they are the representations of 2, 3, 1, 4, of the original square, wherefore they vanish into one point at v . In like manner, and for the same reason, the sides ba, dc , vanish at V . It is evident then, that the representation of a square, having its sides oblique to the picture, is a trapezium *; that is, none of the sides are parallel to each other.

* See its figure Plate II. and its definition page 45.

Case 8.—When a square is situated in a plane perpendicular to the ground, but oblique to the picture, only two of its sides will vanish to a point, as BC , AD , No. 2. The other sides, AB , DC , can have no vanishing point; because they are perpendicular to the ground, and parallel to the picture. See Case 2, page 215. Its representation is therefore a trapezoid. And because the square is not perpendicular to the picture, its vanishing point is not in the center s , but in some other point v in the horizon, according to the angle which the original square makes with the picture, or with its intersection. Thus MAi is the angle which the square AB , DC , makes with the intersection, or ground line GR ; or, in other words, it is the original position which the square stands in to the picture. Hence vd being parallel to MA , it forms the same angle to the vanishing line HL ; and being drawn in this direction from the place of the eye d , and produced till it cut HL at v , consequently v is its vanishing point.

Case 9.—If a square be situated in a plane inclined to the ground plane, and its intersection with the picture be parallel to the intersection of the ground plane with the picture, as AF , No. 3, then the vanishing line of that plane will be parallel to the ground line GR ; and two of its sides, AN , FO , may be considered as perpendicular to the picture; but the other two
sides,

sides, A F, N O, are really parallel, and therefore have no vanishing point in the vanishing line H L. See Case 2, in page 215.

The sides A N, F O, are considered perpendicular to the picture; because, it is evident, that the square may be supposed to revolve on the side A F, and be pressed or moved to 8, 10; which show the angles of the same square in a plane strictly perpendicular to the picture, and therefore its sides 11, 8, 12, 10, have their vanishing point in the center *s*. See Case 4, in page 216. Wherefore, as the square may revolve on A F, as a table top hinged at the front, and rising to any angle from its frame, its vanishing point will rise on the vertical line *s d*, in proportion to that angle. Hence S is the true vanishing point of the square A F, N O, making the angle F A 6 with the ground plane.

Case 10.—If a square be situated in a plane of the above kind, having its sides oblique to the picture, every thing will be considered the same as in the foregoing case, only the sides will vanish to two points in the horizon; neither of which can be in the center *s*, nor in any part of the vertical line *s d*; because the side A B, Fig. 10, of the original square, is not perpendicular to G R. But, as the intersection of this inclined plane with the picture is parallel with the ground plane, as in

Case 9, the vanishing points will rise in a perpendicular direction above the common vanishing line HL , in proportion to the angle which the inclined plane makes with the ground plane.

Hence vv on the new horizontal line bl , are placed perpendicular to VV in the common horizon HL ; which points VV would be the true vanishing points of the original square AB, BC , were it represented upon the ordinary ground plane; or, in other words, if it were represented in a plane perpendicular to the picture, and parallel to the ground plane.

Case 11.—If a square $ADBG$, Fig. 11, be situated in a plane oblique both to the ground plane and to the picture, its vanishing line will be in an angle to the common horizon HL , in proportion to the angle which the inclined plane makes with the ground. For, as the original plane in this case is inclined both to the ground and to the picture, consequently its intersection with the picture will be oblique to the intersection of the ground plane with the picture. Case 9 has a horizontal vanishing line, though it supposes the original plane to be inclined to the ground; but as its intersection is parallel to the ground line, so its vanishing line is parallel also. In the case before us, the original plane has an oblique intersection with
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the picture, and therefore its vanishing line is oblique to the horizon also; which, perhaps, may be better understood by No. 1, showing the same square in the same position, considered as the top of a table viewed angle-ways, whose top is supposed to be rising on its hinges at A C in the angle $\angle A K$. Its vanishing line is therefore $v V$, found by drawing M V, making an angle with the horizontal line H L, equal $\angle A K$, the angle which the inclined plane makes with the ground. Or the vanishing line may be found as in Fig. 11; by drawing $v M$, cutting O m , which is a line perpendicular to the horizon; from the measuring point m , draw M V parallel to the horizon, cutting V P at V; then will the line $v V$ be the true vanishing line as before. The line A X is considered as the intersection of the inclined plane, and is therefore drawn parallel to $v V$, the vanishing line; for, in perspective, it is a universal theorem, according to Dr. Brook Taylor's system, that the vanishing line, intersection, and directing line of any original plane, are parallel to each other; also, "the vanishing points of all lines in any original plane, are in the vanishing line of that plane." See his Sixth and Seventh Theorems. Wherefore the line A X is to $v V$ the vanishing line, the same as the ground line G R is to the horizontal line H L.

These, and the other lines which I have hitherto passed
over

over unnoticed in the various cases, will be explained in the different problems belonging to each particular case, and therefore I deem it unnecessary to say more on them at present.

S E C T I O N III.

Containing Problems in Perspective, solved according to the preceding Principles and Cases—applied to the Methods of drawing rectangular Superficies and Solids in different Positions to the Picture.—Also, how to draw Visual Lines, tending to vanishing Points, out of the Picture; and how to reduce the Point of Distance to any Proportion, so as to bring it within the Limits of the Picture.

IN the methods of instruction generally made use of by most of those who have written on this subject, it is common for them to begin with finding the representations of points and lines, proceeding afterwards to superficies and solids.

To me, however, it appears an unnecessary prolixity, especially it would be so to the persons for whom this treatise is chiefly intended. For to go through all the problems necessary for points and lines as they may be differently situated to the ground plane and picture, and also to show how these lines are to be measured off according to any given length, would take

up as many plates and pages of letter-press as would be sufficient to explain the superficies of figures of which these lines are the boundaries.

Besides, it is presumed that the general readers of this work will understand the various positions of lines, and how to measure them off, according to their given lengths, better when they are connected with some figure, than when these same lines are considered abstractedly. And, in general, it may be said, that when persons set about drawing, it is not to represent a line or a point nakedly, but to draw the perspective appearance of some figure bounded by lines and points; which, when performed, must of course include every thing requisite to the representing or measuring of a bare line. Therefore, in finding the representation of a geometrical square, for instance, the problem for this will teach us both how to find the points of its angles, and at the same time how to represent and measure a line equal to the sides of the given square, or any other figure of that nature. For these reasons I omit points and lines, and proceed to the first problem, which is

PROB. I. FIG. 7. Plate XV.

To represent a Geometrical Square lying on the Ground, having two of its Sides parallel to the Picture, and the other two perpendicular to it.

OPERATION.—Draw the ground line GR, and draw HL for the vanishing line, whose height from the ground line is supposed to be equal to the height of the spectator's eye. Make *s* the center, or that point in the picture which is directly opposite to the eye when the picture is viewed. Make *d* the distance of the eye from the picture, answering to Ps, in Fig. 2, Plate XIV. In this manner the paper or canvass we draw on is prepared for delineating objects in the above situation.

The next thing to be considered, is the seat of the object in the picture; that is, how far the square, for instance, is to be placed to the right or left of the center *s*, or whether it is to be directly under the center, and how far removed back from the picture. These being fixed on, lay down CA equal to the side of the square to be represented, and draw the lines Cs, As, termed visual lines. Determine then how far the square is to be removed from the picture, which in this example is equal 12.

Draw from 2 a line to the point of distance d , cutting the visuals Cs , As , at B and A. Lastly, from these points of intersection at B and A, draw the lines AC , BI , parallel to GR , the ground line, and the representation will be completed as required.

Observations.—The sides CB , AI , of the square, are perpendicular to the picture, and therefore, by Case 5, page 216; they must vanish in s , the center of the picture. The sides CA , BI , are consequently parallel to GR , the intersection of the picture or ground line; wherefore, by Case 1, page 215, they are the representations of original lines parallel to the picture; and being parallel, they can have no vanishing point.

PROB. II. FIG. 7. Plate XV.

To find the Representation of a Square perpendicular to the Ground, and also to the Picture.

THE picture being already prepared in the foregoing problem, the ground line and vanishing line remain the same; also the point of distance and the center s are the same. And it should be observed, that GR is the ground line, and HL the horizontal line in every example. Also s denotes the center of
the

the picture, and d the distance; therefore, in future, the explanation of these may be omitted, and we may proceed as follows:

Operation.—Draw the perpendicular AD equal to the sides of the original square, and draw the visuals Ds , As . Then, on the ground line GR , lay on a space from r to C equal to the distance of the square from the front of the picture. Make CN equal AD , and draw Cd , Nd , cutting the visual As in I and M . Lastly, from I and M raise perpendiculars to KL , and the square will be represented as required.

Observations.—The sides IK , ML , are perpendicular to the ground; wherefore, according to Case 4, page 216, they are the representations of lines originally perpendicular, as AD ; and being perpendicular to the ground, consequently they are parallel to the picture, and therefore can have no vanishing point. But the sides KL , IM , are perpendicular to the picture; therefore they vanish to s , the center.

PROB. III. FIG. 6. - Plate XV.

To represent a Square standing upright on the Ground, but parallel to the Picture.

THE ground line and horizontal line, &c. remaining as in the preceding problem, proceed to the operation. Draw $A D B C$ a geometrical square on the ground line. Draw the visuals $A s$, $D s$, $B s$, $C s$; then lay on a space $A N$ on the ground line equal to the distance which the square is supposed to be from the picture. Draw $N d$ cutting the visual $A s$ in I . From I draw $I M$ parallel to $A C$. Draw $I K$, $L M$, perpendicular to $A D$, $C B$. And, lastly, draw $K L$ parallel to $D B$; then will the square $I K$, $L M$, be the representation of the original square $A D B C$, as proposed.

Observations.—The visual rays $A s$, $D s$, $B s$, $C s$, form a pyramid*, whose base is a geometrical square $A D B C$, and whose vertex is s , the center of the picture. If this pyramid have a section parallel to its base, it must be evident to every one, that the section will produce a geometrical square. The

* See its definition page 97, and its figure Plate VI.

representation I K L M is a parallel section of the pyramid of rays issuing from each angle of the original square A D B C, and therefore I K L M, the section, is a geometrical square. See the conclusion drawn from Case 4, page 216, in which we say,—
 “ That the representation of a geometrical square or parallelogram is a geometrical square or parallelogram, if it be situated in a plane parallel to the picture.”

PROB. IV. FIG. 8. Plate XV.

To represent a Square situated in a Plane inclined to the Ground, and perpendicular to the Picture..

A O P E may represent the inclined plane, which is merely to assist the imagination, or to convey what is to be understood by the square A D B C, No. 1. being in a plane inclined to the ground.

Operation.—On G R, the ground line, draw the semicircle $u n k$, whose radius must be equal to the side of the original square. Draw $n A$ perpendicular to the ground line; then make $n A D$ equal to the angle of inclination which the original square has to the ground. Draw then, as before, the visuals $A s, D s$, to the center s . Let d , near L, on the common horizontal line

H L, be the distance as in common; draw the line $u d$ cutting the visual line A s in C. From C draw C B parallel to A D, then will A D C B be the representation of a geometrical square, situated in a plane inclined to the ground, in an angle of twenty-three degrees.

Method second.—Let G 1, R 1, be the intersection of the inclined plane with the picture; or, in other words, let it be considered as a new ground line, and turn the plate till this line come into the same situation with the eye as the old ground line G R appeared to be in when the plate was upright. This will make every thing in this second method appear quite plain, I presume, and will show that it is as easy to represent a square in a plane inclined in any degree to the ground, if it be perpendicular to the picture, as it is to represent one lying on the ground, having two of its sides perpendicular to the picture. The plate being placed to the eye as above mentioned, draw a new horizontal line $h i, l i$, parallel with G 1, R 1, passing through the center s . Make $s d$ on this new horizontal line equal $s d$ on the old one H L. From D lay down the side of the square D A, and draw the visuals A s and D s. From A draw A d, cutting the visual D s in B. Make B C parallel to A D, and the representation will be as before. In No. 2 the same square is inclined to the other hand; but the operation is still the same, when the new ground line G 2, R 2, is drawn, and when a new horizon

horizon, b_2 , l_2 , is drawn parallel to it, passing through the center s , d near b_2 will then be its distance, or d near l_2 will do, for they are both the same to the square No. 2; since both the diagonals of the square, if produced, will tend to each point of distance, as is evident from inspection. The squares No. 3 and No. 4 are represented above the horizon; but as they are considered in planes perpendicular to the picture, this makes no difference in their representations, for their perpendicular sides vanish in s , the center, and the operation is the same above as below the horizon in all respects. As I have marked the ground lines and vanishing lines to each square, distinguishing them by the same numeral that the squares are marked with, I think it unnecessary to go through the operations, as it would only be repeating what has been said on those below the horizon. See Case 6, on Fig. 8, No. 1, in page 219.

Observations.—From what has been said on Fig. 8, it is evident that the foregoing problem may be applied to useful purposes in representing different pieces of furniture; and that which has been frequently done at random, for want of knowing better, may be done with great ease and accuracy. For instance, the rising desks of the library table, Plate XXX, are represented by this problem. The two semicircles shew that the desk, raised to any pitch, will still be within these arches,

G g

which

which are the boundaries of the desk, as it passes round on its hinges.

PROB. V. FIG. 9. Plate XVI.

To represent a Square situated in a Plane inclined to the Ground and to the Picture, when the Intersection of the inclining Plane is parallel to the Ground Line, or when its Intersection is in the Intersection of the Ground Plane with the Picture.

IN this case the common ground line GR is the intersection of the inclined plane with the picture; and a line, SP, produced parallel to GR will be the vanishing line of this plane.

Operation.—Let HL, the common horizon, be drawn as usual; and let s be the center of the picture. From s to p is the distance of the eye from the picture. Take in the compasses, AF, equal to the side of the square, and with it sweep the arch qr from p ; then from r to q , on the arch qr , lay on the degree of inclination which the original plane has to the ground; and draw pq produced till it cut the vertical line sd in S; then will S be the vanishing point of the square in the inclining

clining plane, for the same reason as s is of the square 11, 12, 10, 8, on the level ground. Make SP equal to sp , and P will be the point of distance to the inclined plane. Draw the visuals AS , FS , and from A draw AP , cutting the visual FS in O . Lastly, draw ON parallel to AF , and the representation of the square will be found as proposed. See Case 9, page 221.

Observations.—The visuals AS , FS , may be cut by another method to the same effect. Thus: draw the line 56 parallel to Sp , and take the side of the original square and place it from A to 5 . Draw from 5 a line to p , the distance on HL , and it will cut at N , as before. The truth of this will appear by comparing No. 1 with No. 3. At No. 1 draw GR for a ground line, and perpendicular to it draw As , a section of the picture. Lay on, from A to s , No. 1, the height of the common horizon; that is, from A to s on the perpendicular line ABs , Fig. 9. From s , the center of the picture at No. 1, draw sp equal sp the distance at Fig. 9. Make AN , the inclined plane, of equal angle to qpr , the angle which the original plane makes with the ground. From A to N , No. 1, lay on AF equal to side of the square No. 3. Lay the same from A to G , No. 1. Lastly, draw Gp , Np , cutting the picture at n and 8 . Take, in the compasses, the space from A to n at No. 1, and lay it from g to N at No. 3, and it will be seen that they are equal. In the same manner take $A8$ at No. 1, and lay it from g to 8 at No. 3, and

it will be found that they are equal. This fully demonstrates the truth of the representation of the square AF, NO ; for, beyond all dispute, n , at No. 1, shows how much the square on the inclined plane rises on the picture; and 8, at No. 1, as certainly shows how much the same square lying on the level ground rises; and since they both coincide with their representations at No. 3, there can remain no doubt but S is the true vanishing point, and P the true point of distance.

N. B. This problem is of use to represent any table top hinged at the front, and rising by a horse behind to any pitch.

PROB. VI. FIG. 9. Plate XVI.

To find the Representation of a Square lying on the Ground, having its Sides oblique to the Picture.

OPERATION.—Draw the plan of the square proposed, as 1, 2, 3, 4, in any angle to the ground line GR , as may be required. Produce the side 1 4 till it cut the ground line at k . Also produce the side 1, 2 till it cut at 1 4. Let s be the center of the picture as usual, and draw sd perpendicular to HL . Let d be the distance of the eye from the picture. From d , draw dV parallel

parallel to 1, 2, one of the sides of the square. From d , draw $d v$ at right angles to $d V$, then will $V v$ be the true vanishing points of the sides of the square; for the line $d V$ is parallel to the side 1 2, and $d v$ is parallel to 1, 4; wherefore $v V$ are the true vanishing points. Hence, from 1 4, and from 3, draw right lines to V , and from k and 3 draw lines to v ; and where these lines cut each other at d, b, a, c , will be the representation of the original square 1, 2, 3, 4, as required.

Method second. — To draw the same square without the trouble of a ground plane.

Operation.—Every thing remaining as before, extend the compasses from v to d , and lay $v d$ to m on the horizon; then will m be the measuring point to the visuals 3, v, k, v . Make $d 13$ on the ground line equal to the side of the square. From 13 draw a line to m , cutting the visual 3 v at b . From b draw $b V$, cutting at a , as by the first method.

The angle of the original square being brought into the picture at 3, a line from 3 to V finds the other side $d c$, without any further trouble.

Observations.—The truth of this problem will appear from what has been said in Case 7, p. 219, which I would advise the reader

reader to examine. And I would further remark, that if visual rays be drawn from each angle of the original square 1, 2, 3, 4, to the vertical line $s d$, they will cut at b, a, c , as in the preceding methods. The rays from $Z X$ to P , in Plate XIV. Fig. 2, are the same to the original $Z X$, as the rays $1 d, 4 d$, are to the side of the square 1, 4, in the figure before us. For $c a$, in this figure, is the representation of 1, 4—and z, x , on the picture in Fig 2, Plate XIV. is the representation of $Z X$.

PROB. VII. FIG. 9. Plate XVI.

To find the Representation of a Square supposed to be situated in a Plane perpendicular to the Ground, but oblique to the Picture.

For this problem, the picture being completely prepared as for the preceding one, the operation will be extremely concise, as follows :

Operation.—Raise a perpendicular line $A B$, No. 2. On the perpendicular $A B$ lay the side of the square from A to B . From B and A draw visual lines to v , the vanishing point; found as before. From A , lay down the side of the square to i ; and from i draw $i m$, cutting the visual line $A v$ in D . Lastly, draw $D C$
parallel

parallel to A B, and the representation will be found as required. See remarks in Case 8, page 221.

PROB. VIII. FIG. 10. Plate XVI.

To find the Representation of a Square having its Sides oblique to the Picture, supposed to be in a Plane inclined to the Ground, as in Problem V.

OBSERVATIONS.—This problem differs in no respect from the fifth, except what relates to the squares represented in these inclined planes. In the fifth problem, the square in that inclined plane, having two of its sides parallel to the picture, the others of course vanish in S , perpendicular to s , the center of the picture. In this problem the square represented in the inclined plane has its sides oblique to the picture, and therefore they vanish to two points in some new vanishing line, bl , parallel to the common one HL ; because the intersection of the inclined plane is parallel to the ground line.

Operation.—Draw, as usual, GR the ground line, and HL the horizon. Let s be the center, and d the distance of the picture. Draw AB , one side of the original square; make

make dV parallel to AB , the side of the square; and draw d, VL , at right angles with dV , then will V, VL , be the vanishing points of the square $4, p, 5, 6$, on the level ground. Make VM equal Vd , and LVm equal LVd ; then will m and M be the measuring points of the visuals tending to V, VL . Thus far the picture is prepared only to represent the square on the level ground; therefore we must proceed to find the vanishing line, points, and measuring points, of the inclined plane, thus:—Draw perpendiculars at pleasure from V , and VL . From M draw Mv , in an angle to VM equal to the angle which the inclined plane makes with the ground. Through v draw bl parallel to HL , cutting the perpendiculars Vv at v ; then will v, v be the vanishing points sought. Make vn equal vM , and n will be the measuring point sought. Draw then the visuals $4v$ and $4vL$. Make $4, o, 4, r$, equal to the sides of the original square BA . From o draw on , cutting at 1 ; and from r draw rp , cutting at 3 . From 3 draw $3v$, and from 1 draw $1vL$, intersecting at 2 ; then will $1, 2, 3, 4$, be the representation of the square proposed.

Observations.—The line tB passes through the diagonal of the original square, whose side is AB . Draw from d , the distance, a line parallel to Bt , cutting at g on the common horizon. From 4 draw a line to g , and it will pass through the diagonal of the square

square 4 *p*, 5, 6, lying on the level ground. Draw from *g*, a perpendicular to *g* on the new horizon *bl*. From 4 draw a line to the uppermost *g*, and the line will pass through the diagonal of the square represented on the inclined plane; which is a clear demonstration of the truth of the whole.

The truth of the method may be proved, also, by drawing a line from A to D, the distance laid on from the new horizon *bl*; for the line cuts the visual at *r*, as in the other method.

PROB. IX. FIG. II. Plate XVII.

To find the Representation of a Square, situated in a Plane oblique both to the Ground and to the Picture.

THIS figure may, to the workman, appear intricate and perplexed; but he ought not to be discouraged at the sight of an assemblage of lines, till, after having made a reasonable attempt to understand them, he finds it not easily attained. But it is to be noticed, that there are several more lines than what are absolutely necessary for representing the square simply considered; because I have shown different methods to effect the same thing; and because the whole process is shown from first to last, that the reader might have a clear

understanding of a problem really useful, but rarely known amongst workmen, and even not amongst painters.

Operation.—Draw GR , the ground line, and HL , the horizon, as usual; and make s the center of the picture. Draw sd perpendicular to HL ; and let d be the distance of the picture. Make the angle dvs equal to the angle which the square in the inclined plane makes with the picture; and draw dP at right angles to dv ; and make vm on HL equal vd . Draw at pleasure mMo perpendicular to the horizon. Make vM to incline in an angle equal to that which the original plane makes with the ground. Draw M, Vx parallel to the horizon; and from Vx , draw Vx, v , which will be the vanishing line of the inclined plane. From the center s , draw sS, dx perpendicular to the vanishing line v, Vx . From s , draw a line to $d1$, parallel to vS, Vx . Extend the compasses from S to $d1$, and make S, dx equal to $S, d1$; then will S, dx be the distance of the picture for the inclined plane. Make $Vx, m2$, equal Vx, dx , and $m2$ will be the measuring point.

The picture being thus prepared for delineating the square, draw from A , the visual Av ; and from A , the visual A, Vx . Draw AX parallel to the vanishing line v, S, Vx . Lay on, from A to w , a space equal to the side of the square; and from w , draw $w, m2$, cutting at D . From D , draw a line to v , for the side

of the square D B. Make also A N equal to the side of the square; and draw N *m*, cutting at G; and lastly, draw G V *x*, cutting at B; and the square will be completed as required.

Method second.—From A, sweep the arch *k* K, whose radius is equal to the side of the square to be represented. Draw A *u* equal to the angle of the inclined plane with the ground; and from *u*, draw *u t* parallel to the ground line; from *t* draw a visual to P; and from *u*, draw *u M*, cutting at D; from A draw a line through the intersection of *u M* with *t P*, and produce this line till it find the vanishing point V *x* in the perpendicular P V. From D draw a line to *v*, as before; and lastly, from G, found as before, draw G V *x*, cutting at B, and the square will be completed, as in the other method.

Observations.—If the original plane inclined to the ground in an angle of forty-five degrees, the visual line of the side of the square A D would pass through the diagonal of the square A, *k*, *n*, 8, and tend to the upper V, the vanishing point in that case; and V *v* would then be the vanishing line, S would be the center of the picture, *m* the measuring point, and *d* 3 its distance, and *v*, *d* 3, Q would be the angle of the inclined plane, which is the diagonal of a square *v*, *d* 3, Q, *m*. It is evident then, that the true representation of a square in any inclination, would

describe a quadrant of a circle, whose radius would be the side of the square represented, as the figure shows.

N. B. No. 1 is the same problem, divested of all lines but such as are absolutely necessary to its representation; which, it is presumed, will be readily understood by inspection, after what has been said on Fig. 11. See page 224.

PROB. X. FIG. 12. Plate XVIII.

To represent a Floor of Squares parallel to the Picture.

G R is the ground line, and H L the horizon.

Let s be the center, and d the distance of the picture.

Let it now be required to represent thirty-six squares.

Operation.—Lay A D, the side of the original square, six times on the ground line G R, contained between A b , as the figure shows. Draw from each division on the ground line visuals to s ; and from b , draw a line to d , the distance; which line will cut each visual in i, k, l, p, q, r . Through the
several

several points of intersection marked by these letters, draw lines parallel to GR , the ground line, and there will be produced the number of squares required. But if it be necessary to fill up the picture with these squares, and there be no room for laying AD on the ground line beyond b , then continue the last parallel line $roabc$ the whole extent of the picture; and take oa equal to the side of the square, and repeat it a, b, c , as may be necessary. From s , draw sb , produced forward to the ground line. In the same manner draw sc forward, and so on repeatedly. Then, lastly, draw parallel lines from the former squares, by which means the picture will be filled up to the sides.

Observations.—The diagonal line bd passes through the opposite angles of the large square A, r, a, b , which includes all the other; and a line through the opposite angles of any of the small squares, will also tend to the same point of distance d .

Of the Representation of Rectangular Solids in different Positions to the Picture.

PROB. XI. FIG. 12. Plate XVIII.

To represent a Row of Cubes, or a Prism, parallel to the Picture.

OPERATION.—The ground line, horizon, &c. remaining the same as for the floor of squares, draw A, B, C, D, a geometrical square, equal to one side of the cube. Draw the visuals A s, B s, C s, D s. From D, draw D d, cutting at 1. Draw 1, 2, parallel to the ground line, cutting D s at 2. From 2 raise a perpendicular, cutting C s in 5; from 1 raise a perpendicular to 4, cutting B s in 4. Lastly, from 4 draw a line to 5, parallel to the ground line, or to BC; and the representation of the first cube will be completed. Next, from 2 draw 2 d, cutting at 3; draw 3, 8, cutting D s in 8; from 8 draw 8 d, and it will find the base of the second cube; and repeating every thing as in the first cube, any number of them may be drawn till they vanish in the point s.

Observations.—If a number of cubes, or prisms, are to be represented in various places on the picture, it will be done with

with the most ease, first, to represent a floor of squares equal to the side of the cubes, or base of the prisms. Thus, for instance, the prism *r* is easily delineated on the back part of the picture, by raising a perpendicular *MN* equal to the original height of the prism. Draw *Ns*, and from any square where it is to stand, raise perpendiculars cutting *Ns* at *r*. From *r* draw a line parallel to the ground line, which will complete the prism. In like manner the cube *ki* may be represented anywhere.

Lastly, we may see, in the representation of a cube, that it consists of three different cases of geometrical squares; that is, *A, D, 1, 2*, is the representation of a square lying on the ground; and *1, 4, 5, 2*, is the representation of a square perpendicular to the ground, and parallel to the picture: and *D, C, 5, 2*, is a square represented both perpendicular to the ground and to the picture. The other three sides of the cube are respectively parallel to those we have mentioned, and therefore are the same in all respects.

PROB. XII. FIG. 13. Plate XVIII.

To represent two Rows of Cubes oblique to the Picture.

OPERATION.—G R is the ground line, and H L the horizon. Let s be the center of the picture, and sd the distance. From d , draw dV , cutting H L in V, and parallel to that side of the original cube; whose representation is A B C g . Draw dv at right angles with dV , cutting at v ; then will v be the vanishing point of the right hand side of the square. Make V M equal V d , and vm equal vd ; then will M m be the measuring points. From A, the angle of the first cube, draw the visual A v . Draw also A V. Make A B equal to the side of the cube, and from B draw B V, B v . Next, lay A B to 7, and from 7 draw a line to the measuring point m , cutting at a . Lay A B to c ; and from c draw cM , cutting at g ; from g and a raise perpendiculars to C and D; from D draw a line to V, and from C to v , which will complete the representation of the first cube.

The space between the cubes being considered equal to the side of the square, repeat A 7 each way on the ground line, as often as there is room, as at 8, 9— d, e, f . From each of these divisions

divisions draw lines to their respective measuring points m M, cutting $A v$ in b and in 2 , and AV in $b i k$. Raise perpendiculars from b and 2 , cutting the upper visuals. Do the same from the other points $b i k$, and proceed in all respects as with the first cube, and there will be two more produced.

Observations.—If it were required to represent two additional cubes to each row, it is evident that we must have recourse to some expedient for this purpose; because there is not room beyond g and f to lay on any more divisions. Therefore from 2 produce a line parallel to the ground line, and from k do the same. And observe, that a line from 8 to m , and from e to M , cut these parallel lines at n and 1 . Extend the compasses from 1 to 2 , and repeat this at $3, 4, 5, 6$, and from these divisions draw lines to m , and they will cut the visual $A v$ in the same points in which it would have been cut if these lines had been drawn from the original divisions on the ground line. Lastly, a line from e to M will cut the left hand parallel at n ; repeat $n k$ at $p q r$, and proceed as before. By this method, which is quite simple, it is evident we may draw as many cubes as we please, by adding parallel lines to the ground line.

Of drawing Visual Lines tending to Vanishing Points out of the Picture.

IN the practice of drawing it is frequently found, by experience, that if we make use of a short distance, the figure we represent will appear distorted and unnatural; and when we, to avoid this, make use of a long distance, it will perhaps exceed the paper or picture we draw on; also, in the representation of objects obliquely situated to the picture, their vanishing points not being in the center, it often follows, as the consequence of choosing a long distance, that the vanishing points far exceed the limits of the picture. To alleviate these difficulties, we propose the following problem.

PROB. XIII. FIG. 14. Plate XVIII.

To represent two upright Prisms obliquely situated, whose Distance and Vanishing Points exceed the Limits of the Picture.

LET the double line on each side of Fig. 14 be considered as the boundaries of the picture. Draw, as usual, the ground line G R, and the vanishing line H L, and make s the center of

the picture. Let sd be considered as only half the distance, because there is no more space in the picture above d . From the point d , draw a right line each way, at a distance from s , equal sd , forming a right angle; because the sides of the prisms are originally perpendicular, to each other. Make vm equal vd ; then would m be the true measuring point, provided sd were the whole distance of the picture; and in this case vp would be the vanishing points of the sides of the prisms; but since sd is only half the real distance, take in the compasses sm , and repeat that space to M , and make sM, sM , equal, then will M be the true measuring point to the whole distance. Produce the vertical line ds to A , cutting the ground line at A . Divide sd into any number of equal parts, as 1, 2, 3, 4, and, for the sake of accuracy, subdivide these as in the figure. Lay on the same divisions downwards from s to A .

The next thing to be considered, is to draw a line perpendicular to the horizon, of such a proportion to sd , at any given distance from s , the center, according to the boundaries of the picture, that when a line is drawn from d , touching the top of the said perpendicular, it would exactly tend to the true vanishing point, were it produced to the horizontal line. We shall suppose, then, that a perpendicular line is drawn from the point v , which is exactly half the distance from s the center, to V the vanishing point

point out of the picture. Make then the said perpendicular line $v4$, half the length of $s d$; then, as one passing from d to 4 would, if produced, terminate at V , the true vanishing point. Divide $v, 4$ in the same manner as $s d$, and downwards from v to 3 lay on the same divisions; for $v3$ is half the length of $s A$. Lastly, make the other scale on the left in the same proportion, then will the picture be properly prepared for delineating the proposed prisms.

Operation.—From A draw a line to 3, which will be the visual for the bottoms of the prisms, for $A 3$ produced would tend to V . Make $A c$ equal to the distance which the prism is supposed to be from the picture; then, from c , draw a line to M , cutting at p ; from p lay a ruler across the two scale lines, and move the ruler backward and forward till its edge coincide with p , and any correspondent division on each scale. The ruler being thus fixed, draw a line $p b$, cutting the scale line $s A$ in the second division, and the scale line $v3$ to the left in the same division; then would $p b$ produced terminate in a point on the horizon equally distant from s as V is. Make $A a$ equal to the left side of the prism, and draw $a M$, cutting at b . Make $c e$ equal $A a$; and from c draw a line to M , cutting at b . From the points p, b, b , raise perpendiculars at pleasure.

Consider now the height of the prism, which we suppose to be AB ; from B place the edge of the ruler, and move it till it be at similar divisions on each scale line, as before. The ruler being in this position, draw a line cutting the perpendicular pD at D ; and from D , place the ruler till it coincide with similar divisions on each scale line on the left, which will complete the representation of the first prism; and for the second, proceed in the same way, observing that, as there is not room on the ground line GR for repeating the side of the prism ce , the scale line, or new ground line bik , must be found, as in the preceding problem, by drawing through b a line parallel to the old ground line, cutting at g , then must the space bg be laid to i and k , from which lines being directed to M , they will cut at lo .

Observations.—In Problem XXI. page 71, Plate II. Fig. 15, the geometrical principle is explained, upon which this method of drawing visuals to points out of the picture is founded.

We there say, in page 72, “ In whatever proportion the extreme line EP is divided, into the same proportion will the hypotenuse line EO be divided.” Agreeably to which, we may observe in the perspective problem before us, that, in whatever proportion the distance sd is divided, a line being drawn from the said division parallel to the horizon, will cut
the

the visual dV in that same proportion. The line sd being divided into two equal parts, a line from z , parallel to the horizon, will cut at 4 , which divides the visual dV into two equal parts; and a line from the point 4 , perpendicular to the horizon, will divide sV in the same manner. Hence it is evident, that if $sd, v4$, be divided into the same number of equal parts, a line drawn through any two correspondent divisions, will tend to V , the vanishing point. It is also evident, by the same mode of reasoning, that if the half distance sd were produced to twice its present length, which would then be the whole distance, a line from d to V would be equal to the space from V to M , on the left the true measuring point, in the same manner as $d v$ measures $v m$, which is only half that space.

Of reducing the Point of Distance, so as to bring it within the Limits of the Picture.

IN making designs on a large scale, it is very common for the point of distance to exceed the bounds of the paper or board we draw on: to avoid the inconvenience of which, let the following problem be attended to.

PROB. XIV. FIG. 15. Plate XVIII.

To find the Representation of a Number of Squares when the Distance is out of the Limits of the Picture.

THE double lines which include the squares, are the boundaries of the paper, board, or picture we draw on.

Operation.—Let s be the center, and let sd be supposed half the length of the point of distance. Make then a scale on the ground line, whose equal parts shall be equal to half the side of the squares to be represented, as 3, 4, 5. Lay on from 3 to 4 half the side of the square A, and from 4 draw a line to d , half the distance, which will cut the visual 3 s in the same point as it would have been cut if d had been twice its present distance from s , and the whole side of the square had been laid on the ground line, as at 5; for it is evident, that a line from 5 through t would terminate in a point on the horizon twice the distance of sd . From 4 lay on 5, 6, equal 3, 4, and drawing lines to d , we shall have the squares B C. Here the learner must observe another difficulty arising; for the ground line of the picture is filled up at 6, and we are supposed to want the representation of three more squares; and as the point 6 is near the extremities of

of

of the picture or board we draw on, there can be no opportunity to lay on the sides of the square any further; We must again therefore reduce the length of the point of distance to b , which is only one fourth of the whole distance; in proportion to which we must also reduce the scale on the ground line to one fourth of the side of the square, as 1, 2; or, which is the same thing, divide the space 5, 6, into two equal parts, and from 6, o , 5 draw lines to b , and three more squares will be cut off on the visual line 3, 5, as is evident from the figure.

Observations.—The truth of the representation of the three last squares will appear, if the whole space between 3 and 6 be placed from 6 to 9. Draw then from 9 a line to d , which will cut the visual in the same points as before, when a line was drawn from 6 to b .

The advantage of this problem is very much experienced in the representation of long ranges of buildings, such as the internal views of streets; in which case it is impossible to find room on the ground line for the full measurement of each front, not even when we have a very large board to draw on. I remember to have been very much embarrassed myself in drawing the view of a long street, till I was informed of the above methods.

SECTION

SECTION IV.

Of the representations of Polygonal and Curvilinear Figures—containing some further Remarks on the Difference between the Representation of Objects on a Plane, and their real Appearance to the Eye.—Of long and short Distances, and the Representation of a Row of Columns and Pilasters, parallel to the Picture; together with some Observations on the Theory of Circular Objects.

Of Polygonal Figures.

LINES in three different positions to the picture, will represent any polygon in any situation whatever*.

A pentagon may have one side parallel to the picture; and if so, the other four will be oblique to it; or it may be placed so as to have all its sides oblique.

* See the definition in page 49, and the various kinds of polygons in Plate II.

A hexagon may be so placed as to have two sides parallel, and the other four oblique, as Fig. 16, Plate XIX. or it may have all its sides oblique.

An octagon may have two sides parallel to the picture, consequently there will also be two perpendicular to it, and the remaining four will be each of them oblique, as Fig. 18, Plate XIX. The octagon in this situation, therefore, introduces all the variety of positions of lines that can exist in a picture, when the figure is supposed to be on the ground plane, or perpendicular to the picture; and since the theory of lines parallel, perpendicular, and oblique to the ground line, &c. has already been considered and applied to practice in the preceding section, in the representation of geometrical squares and of cubes, nothing is requisite here, but to apply the same principles to the representation of polygonal figures.

The most useful of these are the hexagon and octagon; which, for brevity's sake, I shall confine myself to, taking it for granted that, after the learner is acquainted with these, he will be able to delineate any other, from a pentagon to a duodecagon, as it may be found requisite.

PROB. XV. FIG. 16. Plate XIX.

To represent a Hexagon having Two of its Sides parallel to the Picture.

OPERATION.—Draw the ground line and horizon, and make s the center of the picture, and d the distance. Through d , draw a line at pleasure parallel to the horizon. From d describe a semicircle, in which may be inscribed half a hexagon, as 1, 2, 3. From d , through each angle of the hexagon, produce a line till it cut the horizontal line in $V v$; then will $V v$ be the vanishing points of the four sides of the hexagon, which are oblique to the picture. Draw the visuals $F v$, $B v$, and $B V$, $F V$, and make $B D$ and $F A$ each equal $F B$, the side of the given hexagon. Draw $A V$, cutting the visuals at $I K$; and draw $D v$, cutting at $O N$. Lastly, draw $K N$ parallel to $F B$, and the representation will be completed as required.

Observations.—It is evident that a hexagon is composed of six equilateral triangles. The representation contains six triangles also; and if a right line be drawn through each opposite angle, as from $F N$, &c. they will all intersect in the center e , in the same manner as the lines from each opposite angle on the

plan of the hexagon Y intersect each other in the true center, from which a circle may be described that will touch each angle.

PROB. XVI. FIG. 17. Plate XIX.

To find the Representation of a hexangular Prism, or Box, having two Sides parallel to the Picture, as before,

THIS problem may be solved by another method, which will help to confirm the truth of the last method.

Operation.—Draw the plan Y, and produce its sides up to the ground line at g, f, b, c . Find the vanishing points v, V as in the preceding problem. Draw the visuals gV, fV , and bv, cv , which will intersect each other at a, e, t . Through e the center, corresponding with e on the plan, draw bu parallel to q, r , on the plan. From v , draw vb , produced to o ; and from V , draw Vu , produced to n . Lastly, from n draw no , which will complete the bottom of the box. Or it may be done by drawing the visuals $8V, 7V$, when the other visuals are drawn, as the figure itself sufficiently indicates. From each angle of the bottom perpendiculars must be raised, and produced at pleasure. Next, draw gp perpendicular to the ground line, and
make

make $g p$ equal to the height of the box; and draw $p V$, and produce n, o to i ; and from i draw ik , and from k draw a line parallel to the ground line, which will cut the aforefaid perpendiculars drawn from o, n , at 1, 6. The perpendiculars from b, a , were cut by $p V$ at 2, 3. Draw $6 V$, and $1 V$, cutting the perpendiculars from n and i at 5, 4; from 5 draw $5 v$, and from 4 draw $4, 3$, and the outlines of the box will then be completed.

To shew the inside, and the thickness of the edges of the box, proceed thus:—produce from the plan, $x w$, and from w draw a line to V , cutting io ; from its intersection in io , raise a perpendicular to $k 1$; and from its section on $k 1$, draw a line to V ; and where this line cuts the diagonal 2, 5, a line must be drawn from v , the vanishing point, to 9, the point of intersection, and produced till it cut the diagonal 1, 4, at 1; and from where it cuts this diagonal, draw a parallel to 1, 6; and from where it cuts at 6, draw a line to V ; and from where this line cuts at 5, draw a line to v , cutting 4; and from where it cuts at 4, draw a line to the other intersection at 3, and the edges of each angle will be finished.

Observations.—The hexagon in this figure is nearly the same in its plan as the other in Fig. 16; but as it is removed back from the picture, its appearance is more easy and natural

than that. The hexagon in Fig. 16 has one side, FB, in the picture, therefore FB is the full length of the side of the original hexagon, and the contractions of the other sides appear more sudden, and therefore more unnatural; but its representation is equally true. The hexagon may, however, be represented by this method as far back as we please, by repeatedly laying FB, the side of the hexagon, on the ground line, as from D to E, and drawing Ev, by which means we have another hexagon 1, 2, 3, 4, K, Z, whose appearance is perfectly natural.

PROB. XVII. FIG. 18. Plate XIX.

To find the Representation of an Octagon, having two Sides parallel to the Picture.

OPERATION.—Draw GR, the ground line, and HL as in common; and make sd the distance of the picture, and s the center. Draw half the plan of the octagon at A, as follows.—Make bg equal to half the breadth of the plan; and from c sweep the arch b, i, e. Bisect the arch in i. From i draw ic, cutting at p, and pg will be half the side of the octagon. Lay on bp to b1, and a line from p to 1 is one side of the octagon.

Produce

Produce each side of the octagon up to the ground line; and from the points $f, 8, 1, b$, draw visuals to s . From 8 draw a line to d , cutting at 7; from 1 draw a line to d also, cutting at 6. From 7 and 6 draw lines parallel to the ground line, cutting at 2, 3. Draw $f.d$, passing through the diagonal of the square in which the octagon is inscribed. Draw 4, 5, parallel to the ground line. Lastly, draw the sides 1, 2,—3, 4—4, 5—5, 6, and 7, 8; . which completes the representation.

PROB. XVIII. FIG. 19. Plate XIX.

To find the Representation of an octangular Prism, or Box, having all its Sides oblique to the Picture.

OPERATION.—Draw the ground line and horizon, and let figure A be half the plan of the octagon. Let s be the center, and d the distance of the picture. Produce ne, np , to the ground line; and draw g perpendicular to e . From $b, g, 1, R$, draw visuals to s ; and from R draw Rd ; by which a square will be represented in which the octagon may be inscribed.

Draw the other diagonal of the square, which will cut the visual gs in 8; the other diagonal Rd , cuts the visual gs in 6.
From

From 6 draw a parallel to 4, cutting the diagonal at 4; and from 8 draw a parallel to 2, cutting the diagonal at 2; through the center of the square draw a parallel, cutting at 7 and 3. Lastly, draw right lines to each point, and the bottom of the box will be completed.

Draw A F parallel to G R, and at a distance from G R equal to the height of the box. Then represent another square A, F, G, D, and draw the diagonal each way. Then from 8 raise a perpendicular to 10, cutting the diagonal A D at 10. In the same manner, and to the same effect, raise a perpendicular from 6 to 11, from 5 to 13, from 4 to 14, from 3 to 15, from 2 to 16, from 1 to 0, and lastly, from 7 to 12. Draw then, as before, right lines to each point, and the whole representation of the box will be finished, except shewing the inside and the edges of the box: having described how this is to be done in Problem XVI, I need not here repeat it; only it will be necessary to observe, that as the sides of the octagon are drawn by this method without vanishing points, these points must be found by producing the sides of the octagon till they cut the horizontal line H L, in the same way as the side 15, 14, is produced to v, which will be the vanishing point required for drawing the inside line to, as the figure shews.

Some further Remarks on the Difference between the Representation of Objects on a Plane, and their Appearance to the Eye.

WE have already, in page 210, observed, that a perfect picture of objects, as they appear to the eye, cannot be delineated on a plane; we may conceive it to be done on the surface of a sphere, if the spectator's eye be in its center. But this is only a supposition; for, in reality, there can be no strict rules given for drawing perspective lines on a spherical surface. A painter, in delineating objects on the inside of a large dome, may make use of straight lines, and the rules of perspective, as applied to a plane; but he does this, because he perceives that the dome being exceedingly large, and the object but small, the space which the said object occupies on the dome is nearly a level surface; and therefore common perspective comes near enough to the truth for drawing that single object.

But if the object be large, and the dome small, nothing of this sort can be applied.

Mr. Kirby has, indeed, proposed a method to draw perspective representations upon vaulted roofs and domes; and, for

any thing I know, it is as good a method as can be adopted; yet it cannot be called perfect, much less a system of linear* perspective applicable to spherical surfaces*.

But the ordinary rules of perspective applied to a plane is a perfect system, as it relates to the representation of objects according to their real appearance on a transparent plane interposed between the eye and the original figure of any thing: for the transparent plane, in this case, is a section of the rays of light coming from the object to the eye; which section is therefore an infallible and most perfect perspective representation of the original figure on a plane; but it is not so perfect to the eye, because the eye is globular.

Perspective then, as it respects the appearance of objects on a plane, is perfect, and its rules are strictly mathematical; but as it respects the appearance of those objects to the eye, it is a deception, and is therefore liable to defects and imperfections, as every other deceptive art is, owing to various circumstances depending on the management of the artist. These distinctions have not been sufficiently attended to by some, which has therefore been the occasion of some disputes on this subject not well founded.

* As this subject is foreign to my purpose, and not likely to be of use to those persons I wish to serve in this work, I shall not enter upon it, but if the reader chuses, he may consult the third section, page 74, of the above gentleman's book.

Hence

Hence it has been said, by a certain writer, that a row of columns, or cylinders, cannot be represented parallel to the picture, without producing a clumsy and bad effect, if they be drawn according to the strict rules of perspective; for then those columns which are furthest from the center will be the largest, which ought rather to be the smallest, according to their appearance to the eye. But this depends on circumstances, and is not a sufficient reason for charging the rules of perspective with falsity, or even a defect, unless the laws of this art obliged us always to choose a very short distance; and that, when we view a picture, we must necessarily hold our nose close to it, before we can be a judge of the merit of perspective.

From pretty much the same principles another gentleman, who writes on this subject, gives us an instance of the imperfections of perspective, by representing a geometrical square, with a very short distance, which occasions the square to look too long one way, which he therefore terms a false representation, though he has observed the strict rules of perspective. Yet I will venture to say, having made the experiment, that if this gentleman had placed his eye perpendicular to the center of the picture, and at a distance from it equal to that by which he drew the square, he would not have discerned any bad effect even in that which he calls a false representation. But that the learner may have a proper view of this subject, I shall first re-

present a row of columns as they appear to the eye; and, secondly, represent the same row as they appear on a plane, by which the learner will see the difference between Mr. Kirby and Mr. Malton's opinions on the subject. And, thirdly, we shall show the aforefaid row of columns on a plane, having the advantage of a long distance, which, in this case, is recommended both by Maſſon and Noble; the effect of which being a proof that we may abide by the ſtrict rules of perſpective in delineating a row of columns, or any other cylindrical object, and that more pleaſant to the eye than when they are repreſented according to Mr. Kirby's opinion and definition of perſpective, which is, "to draw the representations of objects as they appear to the eye." See page 94 of his Treatiſe on Perſpective.

First, to delineate a row of columns according to Mr. Kirby's definition.

Of the Representation of a Range of equidistant Columns parallel to the Picture.

FIRST, Let I, K, L, M, Plate XX. Fig. 20, be conſidered as a horizontal ſection of the four columns A, B, C, D; and let the arch 1, 2, 3, 4, &c. be the ſection of a ſpherical picture, and d the diſtance of the eye from the picture, then will s be its center.

ter. Draw from the apparent diameters of each column visual lines to d ; and where these rays cut the arch at 1, 2, 3, 4, &c. will be the representation of the diameters of the four columns as they appear to the eye. These diameters and their inter-columns, or spaces between, must now be transferred to a level plane or picture, as in No. 1. Draw a line AB , and take 1, 2, from Fig. 20, and place it at 1, 2, No. 1.; then take 2, 3 from Fig. 20, and place it to 2, 3, No. 1. and so of all the others. Draw perpendiculars from each number, and finish them, as exhibited in the figure, and they will be the representations of the four columns A, B, C, D , as they appear to the eye.

Secondly, We shall now represent the same columns as they appear on a plane, having the same center and distance as before. Draw the line PP , Fig. 20, parallel to the four columns, which will be the section of the picture; and since the visual rays from each column were drawn before, the representations of the apparent diameters of the said columns on a plane will be at ab, ce, fg, bi . Transfer these diameters and their inter-columns to No. 2, as the figure shews; then will A, B, C, D , be the appearance of the four original columns at Fig. 20, on the plane of the picture, according to the strict rules of perspective.

. Now

Now the question is, Which of these representations are most alike to the originals in Fig 20? If the reader will place his eye perpendicular over A, the center column in each representation, and look through his hand at a distance equal d_s , Fig. 20, I believe he will be able to determine for himself; nevertheless it may be proper to offer some remarks by way of assisting his enquiries. And, first,

We may observe that the whole space which includes the columns at No. 2, is considerably nearer the length of the originals at Fig. 20. than the space which No. 1. includes. The intercolumns are nearer alike at No. 2 than they are at No. 1. And, lastly, if we look steadily through our hand as above directed, we shall find that, at No. 2, the apparent thickness of the column D' will be greatly reduced, and that of C will be also reduced, and both in proportion to their distance from the center, so that there will not be much difference in the thickness of each. But if we look in the same manner at No. 1, we shall find the representation appear worse, for D C will appear smaller than they are represented. The reason is obvious, for the rays of light by which vision is performed, being considerably oblique at the column D and C, the optic angles which they subtend are much less than those subtended by A and B, as Fig. 20 clearly demonstrates; for the rays Gd, Hd, are more oblique to the

the picture PP than the rays Nd , Od ; therefore we see that the arch 7, 8 is less than the arch 5, 6, and so of the rest in proportion.

The figure also demonstrates, that when these visual rays are cut by a plane PP, parallel to the original columns, the effect is reversed; for then the representative diameters will increase as they decline from the center s , yet the optic angles under which they are seen remain the same as before, when the visual rays were cut by a spherical picture at 1, 2—3, 4, &c.

Hence it is evident, that the diameter bi , viewed by an eye at d , would not appear larger than the diameter 7, 8 on the arch. Wherefore the true representations of the original range of columns as they would appear on a transparent plane, interposed between the spectator's eye and the said original columns, are at No. 2, not at No. 1, for that is their representation on a sphere, as they appear to the eye, answering to Mr. Kirby's definition of perspective, though this is not what he means to recommend in practice; for he says, page 97, "that they" (meaning a range of equidistant columns) "should be so represented as not to offend the eye of a common observer;" by which he means they should be drawn of one thickness, and at equal distances. How far the representation at No. 1, which is according to his definition,

tion,

tion, will agree to this, I will leave to the judgment of the reader, and shall proceed to shew how these columns may be represented, according to the strict rules of perspective, so as to appear of one thickness, and at equal distances.

We have hitherto supposed the eye of the spectator at d , viewing the original columns A, B, C, D, Fig. 20, in which situation the visual ray Hd , from the farthest column D, and the eye's axis ds , form an angle of fifty-four degrees; and since si is but half the picture, the whole would be seen under an angle of one hundred and eight degrees, which is far too great for viewing any picture; for the eye at d cannot take in a space twice the length of si , without being strained and twisted.

To convince the learner of the truth of this, let him take a pair of compasses and extend them from d to s , and placing one foot on the column A, at No. 2, let the other foot keep his right eye from A, exactly at the distance of their opening, equal ds . Observe, the compass foot must nearly touch the right eye, or the experiment will not be so striking. The eye being thus placed, experience will teach him that he cannot see the column D at No. 2 without twisting his eye; and at the same time he will see, as we said before, that the columns will be nearly equal in thickness. But if the eye d , at Fig. 22, be removed back to E, the

the whole picture will be seen with ease, for it will only subtend an angle of forty-eight degrees; and at this distance, the visual rays being not so oblique to the picture as before, they will cut it nearly at equal distances from each other, as is denoted by the asterisks **, where the dotted rays cut PP. The good effect produced on the picture PP, by choosing E for the distance, is clearly demonstrated by Fig. 21, which exhibits the same row of columns drawn by the distance E.

Thus:—make sd , Fig. 21. half the space of Es , Fig. 20; because there is not room for the whole distance on the plate. From s draw sA perpendicular to HL . Draw GR as a ground line, and proceed as before to lay on the spaces marked by the asterisks **, Fig. 20, on the line PP . Draw then the visuals from A, B, D, C , as the figure shews. From 1, Fig. 23, draw a line to d , cutting As in 2. Through 2 draw a line parallel to GR , cutting the visuals; by which will be represented four geometrical squares, in which the bases of each column will be inscribed. Lastly, from the circles contained in each square, draw the shafts, and finish them as in the figure. Now let the reader place his eye perpendicular over s , and at a distance from s equal twice sd ; then I am persuaded he will say, that a common observer would pronounce the columns of equal thickness, and their inter-columns equidistant, although they are represented according

to the strictest rules of perspective; which Mr. Kirby thinks we must not abide by in this case.

Before I conclude this head, it may be proper to take some notice of the representation of a row of equidistant pilasters.

A little reflection will make it evident, that the representation of a row of pilasters parallel to the picture, are not subject to those awkward appearances which columns are, owing to a short distance. For,

Let the dark line 9, 10, on the column D, Fig. 20, be a pilaster, equal in width to 13, 14, on the column A. Draw the visuals 9, 10, to d' , cutting the picture PP at $i1, i2$; then will the space $i1, i2$ be equal ab , cut by the rays from the pilaster 13, 14; for as the pilaster 9, 10 is to 13, 14, so will $i1, i2, ab$, their representations, be to each other. The same reasoning shows us why columns increase in thickness as they decline from the center of the picture, if we observe where the visual rays, drawn from their apparent diameters, cut the line passing through their centers, as tv, kl ; wherefore, as kl is to 13, 14, so is bi , the representation of the column D, to ab , the representation of A. And hence it is evident, that in the representations of buildings whose fronts are parallel to the picture, their
doors

doors and windows will be to each other as their originals are; that is, if the windows and spaces between them be equal in width, their representations will be equal also; and, as Mr. Martin observes, "all plane surfaces whatever, placed in a front wall or plane, will have in their perspectives no change of figure at all; a square, a parallelogram, a triangle, a pentagon, a circle, an ellipsis, &c. will be all the same figures on the perspective plane, and perfectly similar to the originals; and this will hold good in every part of such a plane in front, as well above and below the horizon, as on each side the eye*."

Of the proper Choice of the Distance of the Picture, proportioned to the Height of the Horizon, and the Nature of the Object to be represented.

FROM what has now been hinted respecting long and short distances, the learner will naturally wish to know some fixed principle about it, and what is the general rule for choosing a distance.

To give him all the satisfaction I can on this subject, I shall propose the following remarks.

* See his Principles of the Genuine Theory of Perspective, page 51.

There is a certain distance shorter than which the eye cannot easily see a picture; and therefore if an object be delineated by such a distance, it will appear unnatural.

In Plate XIV. Fig. 1, let BD be the length of the picture, and Z the place of the spectator's eye, and e the center of the picture, then will Ze be the distance of the picture; but as Ze is very little more than half the length of the picture BD , therefore the angle under which the whole picture would be seen at Z , is almost ninety degrees.

This is an angle which the eye cannot easily take in, because the ray ZB is in a state too diverging to the pupil of the eye, and therefore the spectator must twist and strain his eye, before he could see the whole extent BD .

The optical reason of this is as follows:

Produce the visual rays LP , KP . Now, it is evident, from the scale on the arch, that these rays subtend an angle of more than ninety degrees. Therefore since, according to optical laws, rays will not unite in a point on the retina at a greater obliquity than an angle of forty-five degrees, consequently the points KL will not appear to the eye. This is probable enough from the
figure

figure of the eye, for the image s of K , and o of L , are too far forward in the eye to be seen; but by turning the eyes a little towards K or L , it is evident they will become visible; for then Pe , the axis of the eye, will perhaps be turned to 20 ; or, on the other hand, at 40 ; consequently the angle of obliquity 20 , PK , being considerably less than forty-five degrees, the pencil of rays from the point K will unite in a point on the retina, and so become visible.

A simple experiment will convince the reader of the truth of this. Take a lath two feet long, and at the center fix a wire in a perpendicular direction, about thirteen inches long, or we shall say twelve inches, for then a thread stretched from the wire to each end of the lath would form an angle of 90 ; that is, the threads will be perpendicular to each other. The end of the wire being held close to the eye, the experimenter must look along each thread at once, and try if he can see them distinctly at each end of the lath at the same glance, without straining his eyes. If he continue to do so a few minutes, the pain which this gives will be a sufficient proof that the eye cannot easily take in an angle of 90 ; and that therefore twelve or thirteen inches is far too short a distance for a picture two feet long.

Therefore,

Therefore, in Fig. 1, if the eye be removed to P, the angle which the rays DP, BP make with the picture BD is considerably less, and hence the eye at P will more easily take in DB, the whole extent of the picture; because the rays DP, BP do not diverge so much at the pupil as before. If, therefore, the aforesaid wire be lengthened in the proportion of $P e$ to BD, which will be as twenty-one inches are to twenty-four, the whole length of the lath; and if threads be fixed as before, representing the visual rays DP, BP, the eye P, placed at the end of the wire, will easily see at one glance both the threads BD.

This experiment, therefore, induces me to conclude that a picture which is filled the whole length with objects on the front, should never be drawn by a distance shorter than the perpendicular of an equilateral triangle, whose sides are equal to the whole length of the picture. The angle B, P, D, is equilateral, and $P e$ is its perpendicular; and that I take to be the shortest distance that should be used in this case. And I will venture to affirm, from experience, that any person who has never once thought on this subject, when viewing a picture two feet long, will not stand less than twenty-one inches from it when he wants to see the effect of the whole; but if he would examine minutely some particular part separately, he will naturally

turally approach nearer to the picture, in proportion to the size of the part thus examined. Whence, I also conclude, if nature is to be a guide in matters of delineation and painting, that the distance of the picture should be as 21 is to 24, so is the proper distance to the space which the front objects occupy on the picture. For, supposing a picture two feet long to have only two or three regular objects on the front, occupying not more than two thirds of the whole length, which is sixteen inches, it would not be necessary in this case to make the distance twenty-one inches. A distance of fourteen or fifteen inches would then be sufficient, and produce a more agreeable effect in the appearance of the regular objects, both in front and back, than when drawn by a much longer distance. For, if front objects are too much fore-shortened by a long distance, those on the back ground will be much more so, and appear too tall for their thickness; and the whole picture will want depth, especially if it be an internal view of a street, a long room, or any thing of this nature, where the eye is supposed to be pretty near the first object.

I shall now apply the foregoing principles to a few practical cases, by which the learner will see the effect of long and short distances, and how to choose them on particular occasions..

How to choose a Distance, when the whole Length of the Picture is filled with Objects on the Front.

LET pr, ot , Fig. 22, Plate XX. be the lines which mark out the length of the picture filled with squares on the front.

Extend the compasses from v to v on the horizon, and sweep the arch vD, Dv ; then will their intersection D be the proper distance in this case, and s will be the center. Make sV each way equal sD , and V will be the working distance, as the figure shows.

The squares C, K, N, O , drawn by the distance sV , are perfectly natural. But the squares E, P, Q, R , drawn by sv , are not so; because the distance is vastly too short; for the eye at d views the picture in an angle of ninety degrees, which, as we have already shewn, is far too great, and therefore the representation of the squares are unnatural to a common observer. But if the reader place his eye perpendicular to s , and at a distance from s equal sd , he will find that the unnatural length of the squares, from front to back, will be greatly diminished in appearance.

On the other hand, it is equally necessary to avoid choosing a distance too long; the effect of which is seen at the squares F, where they appear too narrow from front to back; for the distance at z forms, with the whole length of the picture, an angle only of 48 degrees; which should not be admitted, except in particular cases, as in the representation of a row of columns parallel to the picture in Fig. 20, where the eye at E is in the same angle with the picture twice PP, as at z , Fig. 22.

How to choose a Distance, when the Objects are drawn by a large Scale, situated not far from the Center of the Picture.

LET pt , Fig. 22, still be considered the whole length of the picture; and let M be the representation of a square, on a much larger scale than that at C; and let its situation at M be much nearer to F, the center square. From s , the center, extend the compasses to t , the extreme point of the picture, and sweep the arch t, c, b , then will c or b be a proper distance in a case of this kind; for the square M, drawn by the distance c , appears perfectly natural, which would be too long were it drawn by V, the former distance, as appears by the diagonal drawn from io to V, cutting the visual g, s at a . This by no means contradicts what has been advanced in page 178; where we say, that "a picture filled with objects on the front, should never be drawn by a

distance shorter than the perpendicular of an equilateral triangle, whose sides are equal to the whole length of the picture." For, let the line g be now considered the bounds of the picture, and it will be evident, by drawing a line from b to g , that the distance $s b$ is greater to the picture at g , than $s D$ is to the picture at t , otherwise $b g$ would be parallel to $D v$.

Another advantage may be observed in this method, if we consider that a very high horizon will produce as much distortion in a picture as too short a distance. Therefore if we suppose the horizon to be made higher by the space $t i$, the distance will then be $s i$, in the same proportion to it as $s c$ is to $s t$.

How to choose a Distance, when a Piece of Furniture, not very long, is represented by itself on the Center of the Front of the Picture.

If a single object, or piece of furniture, be represented by itself on the center of the ground line, an equilateral triangle being drawn, whose sides are equal to the length of the piece of furniture, the perpendicular of this triangle added to the height of the horizon, will be a very agreeable distance in such a case. Thus, at the square F , supposed to be the plan of a piece of furniture represented on the center of the ground line, extend the compasses from 10 to x , and sweep the arches, to form an equilateral

equilateral triangle, whose perpendicular will be at w ; then will sw be the distance proposed in this case. But if the piece of furniture be of an extraordinary length in front, in proportion to its breadth from back to front, then it will be best to adopt the preceding method; for if we suppose the piece of furniture to extend from 7 to 9, then a perpendicular of an equilateral triangle of that dimension added to the whole height of the horizon, would foreshorten too much. Of these things I am persuaded the reader will be convinced, if he make the experiment as the cases are here stated.

Of the Representations of circular and curvilinear Figures, both plain and solid; together with some Remarks on their Theory.

THE manner in which some painters and designers treat circular objects, would lead one to suppose that there is no certain theory on which to build the practice of drawing objects of that kind.

Sometimes we may see a cask, if not shewing both ends, yet the end on which it stands is represented by a curve considerably more flat than that by which its top is shewn; than which nothing can be more absurd, for the very reverse is the truth.

We may also see, in some cabinet designs, the bottom of a round fronted chest of drawers, or commode, represented by the same curve as that which represents the top part; which, though not so ridiculous as the above, is far from being scientific, or according to the rules of perspective. That the learner may avoid these mistakes, and have a proper conception of this matter, we shall propose the following short theory.

Case 1.—If an original circle be situated in a plane parallel to the picture, its representation will be a circle.

Thus:—Let A, B, O, D, Plate XIX. Fig. 20, be an original plane parallel to the picture H, I, K, in which is situated a circle *a, b, d, e*, whose representation on that picture is required.

The visual rays from each diameter of the original circle tending to the eye E, are cut by the picture or plane of projection H, I, K, in a parallel direction to the original plane A, B, O, D. Wherefore we have the diameter 4, 2 drawn perpendicular to *ad*, its original. Also we have the diameter 1, 3 parallel to its original *be*; consequently the diameters 1, 3—4, 2, are the representations of their originals *ad, be*. C is the center of the original circle, and a line from C to E bisects the triangle *b, E, e*; consequently *c* is the representation of the center C. Lastly, the radii or semidiameters *c 1, c 2, c 3, c 4*, are equal and similar to their originals,

originals, and therefore any one of them, as $c\ 1$, will describe the circle 1, 2, 3, 4, which will be the true representation required. The truth of this may also be proved, by considering the visual rays bE , dE , &c. as the sides of a cone whose vertex is at the eye E , and whose base is the original circle a, b, d, e , and its axis Cc . Now it is evident, that if a cone have a section parallel to its base, the curved boundary of that section is a circle, in like manner as a pyramid, whose base is a geometrical square, produces a geometrical square, if its section be parallel to its base. See page 230. Plate XV. Fig. 6.

By the above theory we shall easily judge how to proceed in the representation of arches, when they rest on pillars or piers parallel to the picture. And it should be observed, that in whatever situation the original arch or circle may be in with respect to the center of the picture, if they be parallel to the picture, their representations will be similar to their originals *.

Case 2.—If an original circle be situated in a plane not parallel to the picture; that is, if it be the representation of a circular object lying on the ground, or in any plane parallel

* The reader may, if he please, consult Dr. Brook Taylor's second corollary of theorem fourth, p. 16.

with it, its representation on the picture will be an ellipsis. The reader who has previously made this subject his study, may ask what I mean by the term ellipsis in this place? since some have disputed whether the representation of a circle in the above case be a regular ellipsis, or a curve of some other species of the conic sections. Mr. Noble has discussed this point in opposition to the critical reviewers, who had censured Mr. Ware in his translation of Sirigatti's perspective, because the translator had defined the representation of an original circle situated in a plane not parallel to the picture, to be a regular ellipsis. In opposition to which definition of Mr. Ware's, the Critical Reviewers for July 1756, page 509, make the following observations.

“ In regard to his regular ellipsis for the representation of a circle, it appears, from the very nature of perspective, that the fore part of a circle will appear more round than the back part, which being further removed from the eye, cannot appear to have the same degree of curvature; and consequently the whole figure, if drawn, must be very far from having the form of such an ellipsis as is to be made by a transverse and conjugate diameter.”

Mr. Noble, in opposition to the above remarks, attempts to prove that the representation in question must be a regular ellipsis; but his arguments are so abstruse, that if they were founded

founded in truth they would not be convincing to the ordinary reader, and therefore I shall not trouble him with them, but proceed to offer a remark or two in confirmation of those made by the Reviewers, which I think easily understood. Let A, B, C, D, Plate XXI. Fig. 23, be the representation of a geometrical square in which an octagon and circle may be inscribed. The circle, truly represented, will touch every side of both the square and octagon, as shewn by the figure. Now, I cannot see by what mode of reasoning we can prove that the ellipsis is regular any more than we can prove that the octagon is regular, because it is the representation of one that is so; but, perhaps, to use Mr. Noble's words, "we are ignorant of those few geometrical præcognitæ which alone can render us capable of conviction on this point:" and this may be the reason why I have considered Mr. Noble's arguments so abstruse*. At the same time I do not think the Reviewers were ignorant of those few first principles of geometry, nor even wanted their recollection, when they animadverted on Mr. Ware. They justly say, "that the fore part of a circle will appear more round than the back part," which must be evident to every one, by observing that the whole curve on this side of the diameter gc , is what they mean by the fore part of the circle,

* The reader, if he choose, may see the arguments in Noble's *Linear Perspective*, page 142.

and all beyond gc is considered the back part of it. We may also observe, that the curves contained in the quarter parts of the ellipsis are not one of them similar to another. How then can we pronounce it a regular ellipsis? When we speak of the perspective appearance of any original object, do we not denominate it by the figure which it assumes upon a plane, and not as it appears to the eye? where then is the good sense or propriety of calling that a regular ellipsis which is no way regular? One would think Mr. Noble had forgotten the distinction which he so properly maintains in other parts of his book, namely, between the appearance of objects to the eye, and their representation on a plane; for if we stand at a distance from the top of a round table, it will appear to the eye a regular ellipsis; but if the top be represented on a picture according to that distance, it will be an irregular ellipsis, and its irregularity will be in proportion to the shortness of the distance of the picture. But suppose we were to consider bd the transverse diameter, and consequently bf the conjugate, yet there is a manifest difference between the two semi-ellipses. Nor is it possible to draw a transverse diameter in such a direction, as when the two semi-ellipses are turned down on each other that they would coincide. Yet it must be observed, that if the representation were drawn in the center, and by a long distance, it would, in this case, approach so near a regular ellipsis as the difference could not be easily discerned.

From

From what has been said, the learner must observe then, that when he proceeds to draw the representation of an original circle, he must not think of applying the compasses or trammel to draw it by; but a number of points must be found, through which the path of the ellipsis must be directed by a hand superior to his who only can draw an ellipsis by a trammel or compasses.

Of the Representations of circular and curvilinear Figures, both plain and solid.

PROB. XIX. FIG. 23. Plate XXI.

To represent a Circle lying on the Ground Plane, or when it is situated in any Plane parallel to the Horizon.

OPERATION.—Let HL be the horizon, and GR the ground line, s is the center of the picture, and d its distance. Make sv equal sd , and draw dV at right angles to dv , then will vV be the vanishing points to four sides of the octagon. Make VM equal Vd . Likewise make vm equal vd , and Mm will be the true measuring points. Draw a half plan of an octagon, as was shewn in Problem XVII. and Fig. 18. Make AD equal to the diameter of the given circle. Draw the visuals $2V$, $1v$, indefinitely.

finitely. Make $2P$, $1I$ equal $2q$, the side of the octagon; and draw from I and p measuring lines to their respective points Mm , cutting at 3 and 8 . From 3 and 8 draw $3s$, $8s$. Take the space $1D$, and lay it from D to 10 , and from A to 12 . From 12 draw a line to V , cutting at 7 , 6 . From 10 to v do the same, cutting at 4 , 5 . Lastly, draw $5, 6$ parallel to $1, 2$, and the octagon in which the given circle is to be inscribed is completed.

Method second.—In this method, which is very simple, we proceed without regard to any of those lines used in the first method, which was more scientific, and according to Dr. Brook Taylor's system. The ground plane F is supposed to remain as before. Let A, B, C, D , be the representation of a geometrical square, found by the diagonals passing to each vanishing point, consequently S will be the center. Through S draw gc , and draw as , from which we have four points, a, g, e, c , of the intended circle. Draw a line from 2 to V , and from 10 to v , cutting the diagonals at b, d , whence we have two more points. From the points b and d draw parallel lines, cutting the diagonals in the points b, f , adding other two; which in all make eight points, sufficient for the representation of the given circle.

N. B. A quarter plan F is sufficient for this method.

Method third.—Draw the quarter plane of the circle to be represented, contained in the square A, E, *a*, O. Draw the diagonal O A; and from the point *n*, where the diagonal cuts the arch E *a*, raise a perpendicular to *t*. Represent a square as before, drawing its diagonals each way. From *t* draw a visual to *s*, cutting the diagonals in the points *b f*. Lastly, from the points *b* and *f* draw parallels to the other diagonals, cutting at *b* and *d*, by which method there will be eight points gained as before. This last method being so simple, and totally divested of every thing that can any way perplex the learner, it has been adopted in the following problems, and in most of the representations in this book. There are, however, various other methods of effecting the same thing, which might prove more pleasing to men of science, but which would not be so advantageous to the workman, nor even to the artist, with whom facility and dispatch are principal objects.

PROB. XX. FIG. 24. Plate XXI.

To represent a Circle situated in a Plane perpendicular to the Ground Plane.

OPERATION.—Let the line R be the ground line, and L the horizon, *s* is the center of the picture, and *s d*, on the vertical line, the distance. Draw half the original circle B, *n*, C. Draw

the diagonals oD , oA ; from A and D represent a geometrical square, by drawing a line from A to d , cutting at F . From $1, 2$, draw parallels to $3, 9$; and from $3, 9$, direct visuals to the center s , and the diagonals of the square will be cut at $8, 5, 6, 7$, forming four points, by which the representation of the circle may be correctly drawn.

PROB. XXI. FIG. 25. Plate XXI.

To represent a Cylinder erect on the Ground Plane.

AFTER what has been said on the preceding problem, it is scarcely necessary to say any thing on this; and therefore I shall only observe, that having drawn the base of the cylinder by the same method as in the last, proceed to raise perpendiculars from A, B, D, C ; and from a draw ab parallel to AB , at a distance from AB equal to the original length of the cylinder. From ab represent another square, as a, b, c, q . Draw its diagonals and diameters. From the point 4 raise a perpendicular till it cut the diagonal bc . From the point 7 raise one till it cut the diagonal aq . Do the same at the points 6 and 5 , and eight points will be found at the top corresponding with those on the base, by which the cylinder may be completed.

PROB. XXII. FIG. 26. Plate XXI.

To find the Representation of a Cylinder lying on the Ground, whose Sides are oblique to the Picture.

OPERATION.—Draw the ground line and horizon as usual; and let s be the center, and d the distance of the picture. Make sv equal sd , and from d draw dV at right angles to vd , then will vV be the vanishing points of the ends and sides of the cylinder. Make a half plan of the base of the cylinder at a, b, c, d , as in the preceding cases. Draw CA perpendicular to the ground line, and equal to the diameter of the cylinder. Draw the visuals Cv, Av , and CV, AV . Make CF equal CA , and CS equal to the given length of the cylinder. Draw Fm, SM , cutting at D and 3 . Draw DB perpendicular to the ground line, and we have a square in which the end of the cylinder is to be inscribed. In like manner represent a square at the other end, as $1, 2, 3, 4$; and having drawn the diagonals and diameters of both squares, draw parallel lines from $5, 6$ to ef . From e and f direct visuals to V , cutting g and b ; from e, f, g, b , draw visuals to v , which will cut the diagonals of each square in four points, by which each end of the cylinder may be completed.

N. B. A circle or cylinder may be represented without drawing a plan, by dividing the given diameter ca into seven equal parts, one of which will cut the diagonals as before, at least near enough for practice.

PROB. XXIII. FIG. 27. Plate XXI.

To find the Representation of a semi-ellipsis, whose transverse Diameter is parallel to the Picture.

OPERATION.—Draw the ground line and horizon as in common, and let s be the center, and d the distance of the picture. Make then a plan of the semi-ellipsis, whose transverse diameter is DG , parallel to R , the ground line. Draw AB , including half the conjugate diameter. Draw the diagonals OB , OA , cutting the ellipsis at P and N . Divide AD at K , and draw EF . From E, P, N, F, O , raise perpendiculars to the ground line at 4, 5, 6, 7, 8, 9, 10, and from each of these draw visuals to s . Make 3, 2, 1, each respectively equal A, K, D ; and from 1, 2, 3, draw lines to d , the distance, cutting at a, k, b . From a, k, b , draw parallel lines to g, l, c ; and lastly, draw oa, og , then will the several visuals be cut at the points requisite for describing the elliptic curve, as the dotted points in the figure show.

PROB. XXIV. FIG. 28. Plate XXI.

To find the Representation of an elliptic Segment inversely.

SUPPOSE A, B, C, D, to be the shelf of any table, &c. hollowed in front in the figure of an elliptic segment, A, 1, 2, 3, 4, B. Having drawn one side A, 1, 2, 3, 4, of the given segment at pleasure, divide the curve into four equal parts, and from 1, 2, 3, 4, raise perpendiculars to a, b, c, f ; then, to make the other side of the curve similar to that already drawn, lay on the several divisions f, c, b, a , to the right hand, and from these let fall perpendiculars at pleasure; then, from 1, 2, 3, draw parallel lines, cutting the corresponding perpendiculars on the right hand, by which the other half of the segment may be accurately drawn. The plan being thus prepared, draw visual lines to s , the center, and make d the distance. At a fix one foot of the compasses, and extend the other to 1, and with it sweep the first arch; and in like manner sweep the arches 2, 3, 4. From the several points where those arches cut the line A D, direct lines to the distance, cutting the several visuals at the points 1, 2, 3, 4. Lastly, from 1 draw a parallel to 7, from 2 draw one to 6, and from 3 draw one to 5; thus will seven points be found through which the path of the represented curve must pass.

SECTION V.

The Application of the preceding Problems to the Practice of Drawing the Representation of Pieces of Architecture, and particularly various Pieces of Furniture in different Positions to the Picture.

THE preceding problems, and the various figures referred to, must be considered as only laying the foundation for the representation of more compound objects, consisting both of right and curvilinear parts. It becomes necessary, therefore, to shew the most easy application of these problems in a variety of examples, that the whole may appear practical and useful, and that we may also see the real effect of that art which we have hitherto laboured to understand. Nor do I think that perspective could well be applied in many cases without such examples. Besides, the usefulness of having a few proper examples always ready to turn to, must be of consequence to those who but seldom represent things in perspective; in which case the rules and methods will frequently escape the memory, and make it necessary to have recourse to the book; and for the sake of more readily finding the explanation of each example, the page of letter-press where the explanation begins, is engraved on the copper-plate, it being a practice sometimes

to look at the plates first for an example of what we intend drawing.

EXAMPLE I. FIG. 29. Plate XXII.

How to represent a receding and returning Flight of Steps whose Risers are parallel to the Picture.

LET HL be the horizontal line, s the center, and d the distance of the picture; GR is the ground line. Make AB on the ground line equal to the original length of the steps, and draw AE perpendicular to the ground, and make the spaces AF, FN, NO, and OE, equal the original height of the risers. Draw visuals from each of these divisions tending to s . Draw FT parallel to AB, and from B and T draw lines to s . Next, lay on the ground line the breadth of the step, from B to a ; and from a draw a line to d the distance, cutting at k ; raise a perpendicular from k , cutting at n ; and from n draw a parallel to p . Then from p raise a perpendicular to q , cutting the visual Ns at q ; draw a parallel to r , and from r a visual to s . Then from a to b lay the breadth of the second step, and draw a line to d , cutting at m ; raise a perpendicular from m to u , and draw a line from u to s , and a parallel from u to w , cutting the visual Cs at w . Lastly, lay on from b to e the breadth of the half space, and from e draw a line to d , cutting at 5 , and raise a perpendicular

cular to x , and from x a parallel; which will complete the first flight.

The returning step leading to the second flight is next to be considered.

For this, draw the perpendicular $y, 7, 8, 9, 10$, at a distance from A equal to the width of the returning steps; draw the line 6, 7, parallel to Y A, and at 6 there is an allowance made for the bearing of the step; also at Z there is an allowance for the other half space to rest on. Draw the visuals $R s$ and $E s$; and how to complete the rest of the steps must be evident from the figure. The returning flight comes forward until it is in the same plane with A B, the first riser; therefore, after having placed the original height of the risers at 8, 9, 10, and drawn from these divisions visuals to s , it remains only to lay on the bearing of the steps at 1, 2, tending to the distance, and cutting at 3, 4. These being traced along the steps, as shewn by the dotted lines, till they cut the visuals $7 s, R s$; how to perform the other part will appear obvious. N.B. The last step of the returning flight 10, 12, does not all come into the plate, otherwise its length would be equal A B, the original length of the step. These steps might have also been represented oblique to the picture; but as I have not plate-room for so many examples, the learner must try if he can do it himself, by reflecting on

what has already been said and done on objects in oblique situations; but if he fail in his attempt, he may consult Mr. Malton's complete treatise, in its practical part.

EXAMPLE II. FIG. 30. Plate XXII.

How to represent a Tuscan Pedestal and Base parallel to the Picture.

DRAW A first, the profile of the pedestal and base, which is taken from the large module of the Tuscan order in Plate VIII. Let H L be the horizon, and make s the center, and sd only half the distance of the picture, for want of room on the plate. Make G R the ground line, and on it, from B to C, lay a space equal to the length of the original plinth. Draw from these, lines to s . Next, consider how far the pedestal is to be represented from the picture, which in this example is equal twice C D; because the whole distance is equal twice sd . Therefore, from D draw a line to d , cutting at F. Make D E equal half B C, cutting at I. Draw F K and I O parallel to B C, by which a square will be represented equal to the plinth. Proceed now to represent the projection of the ogee or base of the plinth. For this, take o, i , half the original projection of the plinth, and place it from B to 2. From 2 draw a line to S, cutting at 3; and from 3 draw one to d , the distance, cutting 4. Draw next

the diagonals *KI*, *FO*. From 4 draw a parallel line, cutting the diagonals at 8, 5, and from 5 draw a line to *s*, cutting at 6; then will be projected each miter of the plinth, and also the size of the dado will be determined at the same time. Therefore from 8, 5, and 6, raise perpendiculars at pleasure, which will serve both for the angles of the dado and the plinth of the base. From *o* draw a line to *s*, which will cut the parallel produced from 8 at 5, and will give an internal miter at 5, *K*; raise perpendiculars from 5, *K* at pleasure. From *c* and 12 on the profile, draw lines to *s*, cutting the perpendiculars raised from 5, *K* at *f*, *m*, which will give the correspondent miter to 5, *K*. Draw the projecting diagonals of each moulding on the profile, as 9, 10, 11, 12, and draw *ab*; from all which points in the mouldings draw visuals to *s*, which will severally cut the aforefaid perpendiculars at *q*, *p*, *n*, *m*, *r*. Draw then the line *mn*, *pq*, which will be the diagonal lines of the internal miters. Now draw parallels from *pq*, which will cut the perpendiculars at 13, 14, 17. From 14, 17, draw visuals to *s*, which will cut at 15, 16; and it is evident that by these the three miter lines will be correctly determined. From each angle of the mouldings on the profile draw lines to *s*, and afterwards observe how the profiles are cut by each projecting diagonal, to which make every perspective miter agree. For instance, draw a line from *v*, the point where the diagonal cuts the upper square of the ogee, till it cut the miter line at *t*; from *t* raise a perpendicular shewn by the

the

the dotted line, which will form the square on that miter, from which the same square must be traced round the dado, as is evident from the figure. In the same manner must the upper moulding be managed; which, after what has been said, it would be a dull and tedious repetition to go through a description of it. And I am persuaded, that if the learner cannot comprehend it from what has already been said and done on the figure, he would fail of attaining it after all that I could say on it. It remains now to consider the base, with a part of the shaft of the column: and this will admit but of very little description, when we suppose the learner already acquainted with representing squares and circles, of which the base is composed; and if he be not, he must turn back to these, for it is impossible to draw a figure to shew all these, without confounding the whole. The principal thing to be observed in this matter is, first, after having drawn x , the plinth on which the base rests, on it a circle must be represented for the bottom of the torus, somewhat less than the plinth, determinable from the profile; after which the projection of the torus must be found, by drawing the lines b, g, w , to s , cutting a parallel from the plinth L at i, k, b . Take half kl and place it from x to z , and a line from z to d , cutting the visual xs , will find the projection of the torus, as the dotted upright line shews. Upon this torus must be represented a square, so much less as the projection of the torus; in this square a circle must be represented to guide the top of the torus,

torus, and having already drawn one for its bottom, by these it may be completed. Next find the height of the fillet above the torus, which is done by drawing visuals from the points above x ; and by a steady hand and good eye the fillet may easily be drawn, by following the upper part of the torus. Lastly, to find the projection of the conge or hollow; take half $k l$ and place it from x to y , and direct a line to d , as before, cutting at the second upright dotted line; how the rest is performed is only to repeat what was necessary in representing the other parts of the base, and therefore it is needless to say more, except to observe the necessity of taking care in drawing the curve lines, so that the torus may seem to rest easy on its plinth, and not appear to start suddenly up, as is commonly the case in such representations, when they are drawn by persons who only understand perspective, but are destitute of taste in drawing.

EXAMPLE III. FIG. 31. Plate XXIII.

How to represent a Tuscan Entablature and Capital parallel to the Picture.

IN the preceding example, the pedestal, base, and part of the shaft, are all under the horizon, consequently the returns of each moulding seem to rise up; but in the example before

us, every part is above the horizon, and therefore each returning member appears to descend. Hence this horizontal line is in a reverse situation to the other, being under the object as the line HL , and that which we formerly styled the ground line, whereon was laid each original measurement, is now at SP , properly termed a section of the picture, on which these must be placed. Therefore having drawn Y , the profile of the entablature, taken as before from Plate VIII. Lay on AB the full extent of the cornice, and from AB draw visuals to s ; divide AB at E , and draw another visual to s . Consider then how far the entablature is to be represented from the picture, which in this example is equal twice EF , because we have only used half the full distance. Draw then a line from F to d , cutting at G ; through G draw a parallel, cutting at IK , which will then be the front edge of the greatest projecting part of the cornice. And since the line from F to d is in a direction only to half the distance, it will cut the visual AD , tending to s , in the same point as it would be cut if a line from K was directed to a distance twice sd ; therefore a parallel line from D to C will represent a square equal to the whole projection of the cornice. It is necessary for the learner to be clear in this, otherwise he will not know what he is about, nor understand the succeeding directions. Having then found this square, draw the diagonals KD , IC , which diagonals must necessarily give the
proper

proper direction to each miter at the top of the cornice. Take then, from Plate VIII. half the upper diameter of the column, and place it each way from E at M N. Draw from M N visuals to *s*, which will cut the aforesaid diagonals at 1, 2, and 3, determining the seat of the cornice, and the other mouldings. Let fall perpendiculars from the points 1, 2, 3. Proceed now to draw lines from each moulding in the profile to *s* the center; and also from Q draw one to the center. Produce the parallel from 1 to 4, cutting the line Q. From 4 let fall a perpendicular, then will the visual line O from the bottom of the cornice be cut at U. From U draw a parallel, cutting the perpendiculars from 1, 2, at 6, 7; from 7 draw a visual to the center *s*, cutting the perpendicular from 3 at 8. Draw the projecting diagonal O 9 of the profile, and strictly observe how it cuts each moulding. Draw also U 10 of the internal miter. In like manner draw 6, 10, 7, 12, and 8, 13. Now from the internal miter, as at *e, a, b, c*, draw parallels, cutting the other projecting diagonals round the cornice, in the same proportion as that of the profile. Every other particular must be obvious from inspection, after what has been said already on the pedestal.

It now remains to find the representations of the architrave and capital. To do this, take the projections *f, g, h*, from the profile, and place them from Q at *i, k, l*, and from these direct lines

lines to *s*, cutting the miter line near *4*, as specified by the points. From each of these points let fall perpendiculars to their respective visuals already drawn; that is, from the point nearest *4* let fall a perpendicular to *m*, from the next point let fall one to *o*, and from the last point let fall one to *n*, which will find the internal miter. From each of these miters draw parallels at pleasure, as shewn by the figure. Lastly, these parallels must be cut, in order to determine the projection of each miter in the representation, which is easily done, by the same method used in the internal miter: thus, from *MN* lay on each way *i, k, l*, the same as *i, k, l*, near *Q*, and direct visual lines to each miter line at *1, 2, 3*. From each of these points let fall perpendiculars as before to their respective parallels, and each miter will be found, as is evident from the figure. With respect to the circular mouldings in the capital, these must be drawn by first finding the squares in which they may be inscribed, and then using that freedom of hand and good taste, which are the best and only guides that can be used in these cases. And here the learner should be put in mind, that the example before us not only shews how to represent the Tuscan entablature, but also how to draw broken mouldings parallel to the picture, or how to represent a cornice round the inside of a room. For if the dotted lines drawn from the internal miter were made good and shaded, and if those returning to the profile were also shaded, the effect would then be seen.

I should have been glad to have assisted the learner in the representations of the other four orders, but he must be sensible that it would be impossible for me either to find room or time for such an arduous task in a work like this, which calls for place and attention to so many different articles. It is my opinion, however, that if the learner thoroughly acquaint himself with the representation of the Tuscan order, he will not be at much loss how to draw the other, except in the capitals of the three last orders when they are oblique to the picture. But these will rarely, if ever, be wanted by those for whom this work is intended. However, if they should, I will refer the reader to Mr. Malton's work, as the best I know of, for their assistance in this matter.

EXAMPLE IV. FIG. 32. Plate XXIII.

How to represent Arches parallel and perpendicular to the Picture.

FIRST, of arches parallel to the picture.

Let A, B, C, D, be an arched passage, whose entrance is parallel to the picture, in which case the arch is similar to its original; that is, a perfect semicircle, as demonstrated by Fig. 20. Plate XIX. and page 284. Therefore let the line 2, 4, drawn
parallel

parallel to the ground be the diameter, and E the center of the arch; sweep the arch as in any other circle; draw the visuals A s, B s, and make *d* the distance. Consider next the size of the pier or pillar on which the arch is to rest. Let AK be the thickness, and draw K*d* cutting at P. Draw PQ parallel to the ground, and raise a perpendicular from Q. From 2, 4 at the spring of the arch, and from E the center, draw lines to s the center of the picture; and the visual line from 4 to s cutting the perpendicular from Q at 3, draw from 3 a line parallel to 2, 4, cutting the visual Es at I; then will I be the center of the furthest semicircle, which completes the arch, by fixing the foot of the compasses in I, extending the other to 3, and sweeping the arch 1, 3, as the figure shews.

EXAMPLE V. FIG. 32. Plate XXIII.

To represent Arches in a perpendicular Direction to the Picture.

LET the perpendicular line A7 be the original height of the arch-way. Draw from 7 a line to the center s, and make 7, 8 equal to the semidiameter of the arch, and from 8 draw a line to s. Next consider how far the arch is to be from the front of the picture, which is here equal AK. From K

Q q 2

draw

draw a line to d , the distance, cutting at P ; and from P raise a perpendicular, cutting at 10. Take 8, 7 equal to the semidiameter of the original arch, and repeat it from K to N , from N to S , from which draw lines to the distance, cutting the visual As in OY . From these raise perpendiculars, cutting at 11 and e ; then will a be the center of the arch. Draw then the diagonals $a11$, $a10$, and divide 9, 10, or 8, 7, into seven equal parts, and take two of these, as at 12; from which draw a line to s , cutting the diagonals, as the figure shews by the points. Through these points draw, by a steady hand, this side of the arch. For the other side of it proceed in the same manner, by drawing visuals from 2, 13. Lastly, draw ac parallel; also 10, 14, and 11, 15; then from c to 15 and to 14 draw diagonals agreeing with the other, and cut these as before, by a line from 16, by which the other side of the arch will be represented; that is, as much of it as ought to appear. The part which does not appear is denoted by the dotted curve. In the same manner proceed with the second, or with as many more arches as may be wanted, by repeatedly laying on the ground line the original measurement at TV .

EXAMPLE VI. FIG. 33. Plate XXIV.

How to represent a House in Perspective, having its Front parallel to the Picture.

LET HL be the horizon, and GR the ground line, s is the center, and sd the distance of the picture. Make AC the original length of the front, from which draw visuals to s . Consider next how far the house is removed back, which is here equal CI . From I draw a line to d , cutting at 7 ; and from 7 draw a parallel to 8 . Draw a plan of the roof $1, 2, 3, 4$. And from d the distance, draw dv parallel to the side of the roof $1, 2$; then will v be the vanishing point for that side of the roof. Take sv and place it below the horizon at V , perpendicular to s ; then will V be the vanishing point of the other side of the roof $2, 3$. From 8 and 7 raise perpendiculars at pleasure, and make AF the original height of the front. From F draw a line to s , cutting at 9 ; draw a parallel from 9 to 10 . For the windows and door, lay their original measurements on AF and AC , drawing visuals to s , as the figure shews; and as the front is parallel to the picture, consequently each object on it is similar to their originals*, and therefore lines perpendicular to $8, 7$,

* See pages 274 and 275.

and 9, 8, will form the sides, tops, and bottoms of each window and door-way. From 9, 10 draw lines to *v*, the vanishing point of the roof; from 10 draw a line to *s*, the center. Take then 1, 3, the span of the roof, and place it from *F* to *B*; and from *B* draw a line to *s*, cutting at 11; from 11 draw a line to *V*, below the horizon, cutting at 14; from 14 draw a parallel to 13, for the top of the roof; and from 13 draw a line to *V*, cutting the line 10 *s* at 15, forming the farthest side of the roof; draw a perpendicular from 15 to 6, which will complete the end of the house. Lastly, to find the height of the chimney, draw a line from *s* through 14, cutting at *E*; and from *E* lay on the original height of the chimney to *D*; and from *D* draw a line to *s*, cutting a perpendicular from 14, which will give the height required.

Method second.—The front of the house being drawn as has been described, to find the appearance of the roof and gable-end, draw the roof 1, 2, 3, as before; and from 4 and 3 draw lines to *d*, cutting at 5, 6; from 5, 6 raise perpendiculars at pleasure; from 5 draw a parallel to *O*, cutting the visual *A s* at *O*, for the center of the left gable-end; from *O* raise a perpendicular at pleasure. Take then the perpendicular height of the roof, from 4 to 2, and place it from *F* to *E*; and from *E* draw a line to *s*, cutting the aforesaid perpendicular at 14, which will give both
the

the pitch and height of the roof. From 14 draw a parallel to 13, cutting the other perpendicular correspondent with 14. Lastly, from 9 draw a line to 14, and from 10 draw a line to 13, and from 13 to 15, which will determine the appearance of the roof, as before.

EXAMPLE VII. FIG. 34. Plate XXIV.

To find the Representation of a House whose Gable-end is parallel to the Picture.

IN this case the front that was before parallel to the picture is now turned perpendicular to it. The gable is therefore parallel to the picture, and is nothing more than a geometrical elevation, found by laying on the heights on $a b$, and the widths on $a f$, and drawing lines from these to s , the center; $m f$ is the distance of the house from the picture; and a line from m to d , cutting at n , finds the representation of that distance. The other lines to the left of m , all tend to d also, by which the windows and doors, &c. are found; $m q$ is equal to the original length of the front, a line therefore from q to d determines its apparent length on the picture. For the pitch of the roof, draw $e s$, cutting at p ; from which raise a perpendicular; draw another perpendicular from w , the center of the
other

other gable-end; also draw the visual ks, ls , for the roof; which visual will cut perpendiculars at b and i , answering to the points lk , by which the roof is formed. For the rest, the figure itself is sufficient, by observing that ut is the perpendicular height of the roof, and tb of the chimney. ..

EXAMPLE VIII. FIG. 35. Plate XXIV.

How to represent a Chair, having its Front parallel to the Picture.

AFTER having made a scale of feet and inches to proportion each part of the chair by, draw A, the profile of the back and side rail; and draw B on the right, according to the bevel of the seat; and observe, to distinguish the lines of each chair, one is marked with small letters, and the other with numerals.

Let HL be the horizon proportioned by the scale, about five feet high from GR the ground line. Make ab equal to the length of the front; from which draw lines to s , the center, which, in general, ought to be perpendicular over the middle of the chair, because it affords the most easy and natural view of its back. Next, from q , the width of the seat, draw a line to the distance, here out of the plate, cutting the visual as at c ;

from c draw a parallel to e at pleasure. Take CD , the bevel of the seat, and place it from a to d ; and from d draw a line to s , cutting ce at y , which gives the bevel of the seat. From a draw a line through y , cutting the horizon at V , which will be the vanishing point to every line originally parallel to ay , the side rail; take sV and place the same space to v , which will be the vanishing point to the other side of the chair; therefore from b draw a line to v , cutting at e , which forms the seat. For the thickness of the back rail, draw a line from p to the distance, as the figure shews. For the height of the back, raise a perpendicular ag , and draw a parallel from r to g ; draw also a perpendicular from y , and a line from g to V will cut it at f , determining the height of the back. For the bottom of the back foot, draw a line from u to the distance, cutting a perpendicular from c at w . From w draw a parallel, and from z draw a line to the vanishing point V , cutting at x , which will determine the place of the back foot*. How every other part is done, must be evident from inspecting the figure.

* The reader will perceive that the line from z to x is not accurately drawn, for the engraver did not follow his copy, otherwise the line would have touched the bottom of the back foot tending to V , which the learner may prove, by drawing a line from z to V . This instance may serve to shew the trouble there is with engravers, who in general are totally ignorant of perspective.

EXAMPLE IX. FIG. 36. Plate XXIV.

How to represent a Chair having its Front perpendicular to the Picture.

IN this example the same ground line, horizon, center, and distance, is used as in the preceding; therefore let the space 7, 1, be equal to the length of the chair front. From 7 draw a line to *s*, and from 1 draw a line to the distance, cutting at 16. Make 7, 9 equal to the length of the side rail, and from 9 draw a line to *s*; make 9, 10 the thickness of the back foot, and from 10 draw a line to *s*, as before. Draw a parallel line for the depth of the side rail, and from 8 draw a line to *s*. Next consider how much the back foot sweeps off from the perpendicular, which is equal to the space 12, 13, or 2, 22; draw visuals from each of these points, as the example directs. To find the bevel of the sides, take CD and place it from 7 to 5, and from 1 to 3; from which draw lines to the distance, cutting at 11 and 17; from 11 and 17 draw parallels cutting the visual 9*s* at 20 and 18; from 7 draw a line to 20, and from 16 draw one to 18, which will finish the outline of the seat. Lastly, from 18 and 20 let fall perpendiculars, cutting at 24, 25; from which draw parallels to the visual 13*s*, which gives the bottom of each

each back foot; and for every other particular, a little reflection and observation will be sufficient.

EXAMPLE X. FIG. 37. Plate XXV.

How to represent a round Table in Perspective, having two of its Claws in front parallel to the Picture.

DRAW a profile of the pillar and claw, as at A. Take $a b$, the spring of the claw, from the center of the pillar, and with it describe a circle 1, 2, 3; divide the circle into three equal parts, so as to suit the intended position of the claws, as 1, 2, 3; draw from these perpendicular lines to i, e, f . Represent a square 4, 5, 6, 7, equal to the diameter of the top; draw the diagonals and diameters of the square, and from $i f$ draw visuals to s ; from C, the center, draw a perpendicular for the pillar; and having determined the height of the table at B D, from B D represent a circle for the top, as has been taught in page 289, see Fig. 23. Next find the place of the claws; for which make $f e$ equal $f 2$, and from e draw a line to the distance d , cutting at g ; from g draw a parallel to b , for the other claw. To find the place of the back claw; extend the compasses from e to 3, and make $4 c$ equal to it; from c draw a line to the distance, cutting at m ; and from m draw a parallel to i , which will be the place

of the claw. For the different parts of the pillar, draw from the profile lines to the distance, cutting the perpendicular CF , as the figure shews. It now remains for every part to be finished by a good hand and eye accompanied with judgment, as no other rules can be of any service in cases of this sort.

EXAMPLE XI. FIG. 38. Plate XXV.

How to represent an octagon Table having one of its Claws in Front perpendicular to the Picture.

DRAW the profile of the pillar and claw, as at B ; and, as in the other example, take the spring of the foot or claw from the center of the pillar, and with it describe a circle, and mark out the place of the claws at 1, 2, 3. Draw 1, 2, 3 up to the ground line, and produce 1 up to u , for the height of the table. Represent a square both at top and bottom, and draw the diagonals, finding the center for the pillar. Draw now the dotted lines from the profile to ~~the~~ the perpendicular, and where they cut draw lines to s , the center of the picture, cutting the center of the pillar for each respective moulding. Next find the situation of the claws; having drawn lines from k, b, a , to s , make $b b$ equal $b i$; and from b draw a line to the distance, cutting at g , which will be the place for the first claw. Make $a c$ equal $a 3$, and from c draw a line to d , as before, cutting at b ; from b draw

draw a parallel to e , then will $b e$ be the place of the two other claws. From 5 and 4, produced from 7, the height of the toe, draw lines to s ; and from e and b raise perpendiculars cutting these, which will be the height of the toes of the back claws. Lastly, we here suppose the top to be an irregular octagon, wherefore let $m n$ be equal to four of its sides; draw from $n m$ lines to s , from n draw a line to d , cutting at o ; from o draw a parallel to t ; finding the opposite angle, draw $m t$; and from the distance draw a line through w , cutting at r ; from r draw a parallel to p ; and draw $p q$, which will finish the octagon for the top.

EXAMPLE XII. FIG. 39. Plate XXV.

To put a Commode Table in Perspective, having its Front parallel to the Picture.

OBSERVE, the ground line for the tables is here used as the horizon for the commode.

Make $s d$ half the distance, for want of room on the plate, and make $G R$ the ground line. Draw then the plan P of the front, according to the intended scale. And, in cutting of each visual line, use one half of a foot instead of a whole one; because only half the whole distance is used. Therefore, having
drawn

drawn the visual $3s$, Bs , draw a line from 1 foot on the scale line to d the distance, cutting at g ; then will $3g$ represent a line two feet long, equal to the breadth of the commode. From g raise a perpendicular, cutting at m , finding the apparent width of the top; draw 5 , 10 parallel and equal to the height of the foot and bottom of the commode; draw parallel lines, also, for the partition below and above the drawer, and for the top, as shewn by the figure. Proceed now to find the place of the feet and the sweep of the front: for the feet take half 3 , 4 , and from 3 place it to 6 ; from which draw a line to d , cutting at 2 ; from 2 draw a parallel cutting Bs , for the other foot. Find now two points by which to direct the sweep of the front thus: draw perpendicular lines from the plan at 9 , 12 , and from 13 , i , k , where they cut, draw lines to s ; then take half 8 , 9 and place it from k to i ; and from i draw a line to d , cutting at p , finding a point for the curve; from p draw a parallel to t , finding the opposite point, which will be sufficient for the whole. Lastly, for the recess draw visuals from r f , and, supposing the recess to be a foot deep from front, make ef equal half a foot on the scale; draw from e a line to d , cutting at o ; and from o draw a parallel to the opposite visual. Every other thing may be learned by observation, without going through a minute detail of every particular, which would become an exceeding dry task indeed.

EXAMPLE XIII. Fig. 40. Plate XXVI.

How to represent a Chair obliquely situated to the Picture.

IN the two former examples of chairs in perspective, the first of these had its front parallel to the picture, which is the most usual way of representing a chair when it is wanted to be viewed as a pattern; for the back being parallel also, it gives the most natural and distinct view of the banister and all its parts. The second is put with its front perpendicular to the picture, which is a position wanted in the representation of internal views of rooms or passages: and this third example being put oblique, is considered by painters most picturesque or suitable for a picture, in which case the pattern of the chair is not much regarded, only its unformal situation suiting to the subject and circumstances of the design. In this example I shall therefore consider myself as offering some assistance to the painter, as well as in a few other instances in this book.

Observe, that the vanishing points v V, and measuring points m M, of this example, are all found by laying the distance downwards to D, for want of room on the plate, and which needs not here be explained, after what has been done
in

in problem VI. page 236, as it makes no difference whether the distance be above or below the horizon. Therefore proceed in considering GR the ground line, drawn parallel to the horizon HL; on GR make a scale of inches to proportion every part by. Make af equal to the original length of the front, which in parlour chairs is generally 21 or 22 inches; and let ag be equal to the width of the seat from the inside of the back to the front, commonly 16 inches. As a is considered the nearest angle to the picture, from a raise a perpendicular at picture, on which the original heights of each part must be laid, as from a to m , for the height of the seat rail, about 16 inches without the stuffing. From a and w draw visuals tending to V and v . From fc draw lines to m , cutting at xy ; from b do the same, cutting at 3; from which points raise perpendiculars for each foot. Next, from g draw a line to M, cutting at k ; from which raise a perpendicular to o ; from o draw a line to V; and from 4, the inside of the front foot, whose thickness is supposed equal to the bevel of the side rail, draw a line to v , cutting at p ; then from w , the outside of the foot, draw a line to p , produced till it cut the horizon at o , which will be the vanishing point to every line originally parallel to the side wp . From v extend the compasses to o , which lay on to O, and O will be the vanishing point to all lines parallel to the other side ts . Therefore, from t draw a line to O, which will cut at 5, completing the form of the seat. On the perpendicular line from w ,
lay

lay on 21 inches for the height of the back, and direct a line to o , and through p draw a perpendicular at pleasure for the joint of the side rail. Next consider how much the back foot pitches, which in this example is equal bg , and bi is for the thickness of the toe. From these draw lines to M , cutting at k, l, n ; and from k, l, n , draw lines to V , which will cut the visual bv in the place for the toe at 8, 6; from 6 raise a perpendicular cutting at 7, and from 7 direct a line to V , for the top rail; and how the rest is performed must be obvious from what has already been said and done.

EXAMPLE XIV. FIG. 41. Plate XXVI.

To put a Cylinder Desk and Book-case in Perspective, having its Front oblique to the Picture.

DRAW first an elevation of the cornice and pediment, and proportion the pediment according to Fig. 36, Plate V. by dividing half the length of the cornice into nine equal parts, of which take four for the pitch. Take one of these parts for the height of the pedestal, and the remaining three for the vase. Draw lines up to the ground line at q, r, F, p, f , and the vanishing points having been already found, draw from r lines tending to each; from r , the nearest angle of the book-case, raise a
S f
perpendicular

perpendicular at pleasure, on which the several heights must be laid. From *r* to *A* lay on the depth of the lower part, and direct a line to *M*, cutting at *U*, and make *AB* the depth of the book-case, and draw a line as before, cutting at *X*, from which raise a perpendicular. In the same manner draw lines from *F p*, tending to *m*, and cutting at *3, 12*, for the length and center of the book-case. The several original heights for the desk part, doors, and cornice, must now be placed on the perpendicular, from which lines must be drawn to each vanishing point. And here we must observe, that as the nearest angle of the book-case comes forward to the picture*, consequently the slider is on this side of it. To project the slider in this case, a vanishing point must be found, from which, if a line be directed it will pass through the diagonal of any square. Thus: on *D*, the distance, sweep the arch *S*, and bisect it at *S*, and through *S* direct a line to the horizon, cutting at *d* on the small drawers; lay from *r* to *g* a space equal to the projection of the slider; and from *g* direct a line to *m*, cutting at *i*; from *i* raise a perpendicular to *y*; and from *d*, the aforesaid vanishing point, draw a line through *y* at pleasure; and from *v* draw a visual for the end of the slider, cutting at *n*; from *n* draw a line to *V*, and from *v* draw one through *10*, for the other end of the slider. The opening of the door is next to be considered. It is evident

* When any object is represented to touch the ground-line, that part which touches it is said to be in the picture.

that a door turning on its hinges must describe a semicircle, and therefore if a semi is represented, whose radius is equal to the breadth of the door, its circumference will determine any opening that can be proposed.

To describe the semicircle proceed thus.—From the vanishing-point *v* draw a line through *z*, the center of the book-case, and produce it at pleasure; then from *d*, the vanishing point of any diagonal, draw a line through *12*, cutting at *C*; from *C* draw a line to *V*; and from *v* draw a line through *12*, cutting at *K*; and from *K* draw another diagonal to *d*, cutting at *w*; from *v* draw a line through *w*, cutting at *E*, and produced to *Q*, cutting a parallel from *C*; from *12* to *E* draw a diagonal, and if the door is intended to be opened 45 degrees more than square, produce this diagonal, as shewn by the dotted line, till it cut the horizon, and its intersection with it will be the vanishing point for the top and bottom of the door. Divide *CQ* into seven equal parts, and from one of which at *7* direct a line to *m*, cutting at *13*; and from *13* draw a visual to *v*, cutting at *1*; from *1* draw a visual to *V*, cutting the other diagonal at *2*; from *2* raise a perpendicular for the apparent breadth of the door in this position; and from the last mentioned vanishing point found by the dotted line, draw lines for the top and bottom of the door, by which it may be completed. For the ends of the cylinder we need not say any thing, as this is the same as in pro-

blem XXII. therefore we shall proceed with the cornice and pediment.

Set off the projection qr of the cornice at 6, 5, on a parallel line drawn at the full height of the book-case, and draw lines to v , and the line 5 will cut the perpendicular raised from X , and the line 6 will cut a perpendicular at 8, supposed to be raised from t , the miter point of the cornice, which is found by drawing a line from d , the vanishing point of the diagonal to X , cutting at t ; from t direct a line to V , cutting at a ; and from a raise a perpendicular, which will cut a line drawn from 8 to V , at the other miter point; every other part of the cornice must be finished by the reader's judgment, governed by these principles, as it would be impossible to apply every rule in such small examples.

Lastly, for the pitch of the pediment, a vanishing point must be found, according to the principles in Problem IX. Plate XVI. by drawing a line from m parallel to the pitch line at the elevation P , produced to VP , cutting a perpendicular from V ; from 8 draw a line to VP , cutting a perpendicular in the center of the front edge of its cornice; from which draw the other side of the pediment, which, if produced, would cut a point as much below the horizon as VP is above it. These pitch lines being found, the scroll pediment may be drawn by hand with

sufficient accuracy; but if the pediment be a straight pitch, then the lines for each moulding must tend to V P, and to a point as much below the horizon. And I would here observe, that in drawing after these examples, it is not intended that the distances made use of in them should be a precedent to the learner. These are chosen to suit the plate; but the learner having sufficient room on his drawing-board, must choose his distance to give the most natural and pleasing effect to his drawing, by the rules already laid down. See page 275.

In these examples almost every difficult part of perspective is introduced, and it is presumed that, after the learner has made himself fully master of them, nothing will occur in practice that can give him much trouble, especially if he be properly acquainted with the short theory that has been given. However I am fully persuaded, that no cabinet-maker or upholsterer will ever want to practise more; and, if I am not mistaken, there are but very few painters who are at the trouble of practising so much. But if the reader's profession or necessities should require him to extend his skill in this art further than what has been advanced in this treatise, I will freely refer him to Mr. Malton's complete Treatise, from which, it is here gratefully acknowledged, I have received considerable assistance.

SECTION VI.

Containing a short View of the Nature and Principles of Shadows, caused by the Sun coming in different Directions to the Picture; together with some Remarks on the Effect of Light and Shade in general.

WHAT has hitherto been done in the foregoing sections is termed by artists linear perspective, which proposes rules for drawing the outlines of objects in every situation, proportioned one to another according to their magnitude and distance from the picture; but the subject of the present section is to propose rules for giving effect to these outlines, by the different circumstances of light and shade. The mere outlines of a drawing is but as a skeleton without flesh or life, but by the addition of proper light and shadow, we may almost behold nature in a picture: and that which before appeared flat and insipid, now obtains the force and effect of the objects themselves.

The doctrine of light and shadow may be considered under three heads. As,

First, when the force of the sun's rays fall on objects, and thereby produce a shadow strongly defined.

Secondly,

Secondly, When the sun is not supposed to shine, and the shadow is only produced by light simply considered, or by reflection.

Thirdly, When the light or shade of one object is proportioned with that of another at a greater distance in the same picture. This is termed the aerial part of perspective, or the diminution of tints according to the distance of objects.

The first of these heads is, however, that which principally concerns us, it being reducible to strict rules; the second follows of course; and the last can only be learned by observation and practice.

In considering the shadows caused by the sun's rays we may observe the following distinctions.

First, When the sun's rays are in the plane of the picture, or, which is the same thing, when they are considered parallel to it.

Secondly, When the rays come from behind the picture.
And,

Thirdly, When they have their direction from the front of the picture.

CASE I. FIG. 42. Plate XXVI.

To project the Shadows of Objects, in various Positions when the Sun's Rays are parallel to the Picture.

THE sun, which is the great source of light, being at an immense distance from the earth, the rays of light issuing from it in right-lined directions, are considered as parallel to each other. The truth of this is proved by the parallel shadows which it always produces on a plane from objects which are parallel to each other and of equal thickness.

When, therefore, the rays are considered as parallel to the picture, the shadows of all objects are found by parallel lines passing by the angles of each object, and in such a degree of inclination as the sun is supposed to be in, either to the right or left of the center of the picture. These lines, representing the sun's rays, being cut by lines from the bases of each object drawn parallel to the ground-line, find every shadow in this case.

The learner will recollect, that in stating the theory of lines parallel to the picture in page 215, it is there said, " Lines
" which are parallel to the picture can have no vanishing line

or

“ or point in it, because if infinitely produced would never “ cut it.” The same holds good in the theory of shadows when the sun’s rays are parallel to the picture; for then they cannot cut it, and consequently a vanishing point is not wanted in this case.

Hence the shadows of all lines perpendicular to the ground are drawn parallel to the ground line; and as, in perspective, all lines perpendicular to the picture vanish into its center, so likewise the shadows of every such line will tend to it. Therefore,

EXAMPLE I. Fig. 42

SUPPOSE A to be the representation of a wall perpendicular to the ground and to the picture. R R is a ray from the sun inclining to the left in an angle of forty-five degrees, therefore the shadow 2, 3 of the perpendicular line 1, 2 is equal in length to the line itself. Draw the other ray r r parallel to R R, and the shadow r o will be equal to the height of the wall o r. The line 1 r is originally perpendicular to the picture, and vanishes in s, the center; so is its shadow 3 r, which likewise tends to it.

EXAMPLE II. Fig. 42.

SUPPOSE EB an object any where on the ground, whose sides EB are oblique to the picture. Draw through each angle a ray rr parallel with RR the given one, and draw lines from the foot of each perpendicular, as 4, 6, parallel to the ground line, and their sections with each other will form points for the outline of the shadow. Lastly, from the point 5 draw a line to 7, and from 7 draw one to 8, and filling it up, the shadow will be completed.

Observe, the line 4, 9, and its parallels, are not perpendicular to the picture; therefore its shadow line 5 7 does not tend to the center, but to the same vanishing point necessary for drawing the side B. In the same manner the shadow line 7 8 vanishes to the point requisite for drawing the side E.

EXAMPLE III. Fig. 42.

LET D be an object having the side D inclined to the horizon, and the other sides oblique to the picture. Draw a ray through b , and through f parallel to the given ray RR ; from g the foot of b , and from d the foot of f , draw lines parallel to the ground

ground line, which will intersect the rays at a and c . To complete the shadow, draw a line from the extremity of the inclined plane to a , and from a to c .

EXAMPLE IV. · Fig. 42.

LET F be the stump of a column resting on one end, whose shadow is required. Find the diameter of the column each way, both at top and bottom, as the figure shews; and through the extremities of these diameters draw parallel rays as before. Lastly, from the foot of each perpendicular falling from the center and diameter, draw lines parallel to the ground line, cutting the rays at v, w, x ; draw a curve to pass through these three points, and the shadow will be projected.

Thus it is evident how easy a matter it is to project the shadow of any kind of object when the rays are parallel to the picture, and when the shadow is to fall on the ground plane, as in the foregoing examples.

It is, however, sometimes necessary to project shadows falling on other objects contiguous to those whose shadows are required. Therefore,

EXAMPLE I. Fig. 42.

SUPPOSE the object D standing in the way of the shadow of A, a plane of rays passing by the end 1, 2 of the wall, will make a section of D at $t, i, 3$; which is found by drawing the line from 2 through to 3, and from 3, where it cuts the ray RR, raise a perpendicular to i , and from i draw a line to t , which will determine how far the shadow comes in front. Lastly, the base line $t d$, of the object D, cuts a line from 3 at e ; therefore, from e raise a perpendicular corresponding with $3 i$, and from i draw a line to the aforesaid perpendicular, and the shadow, so far as it affects the inclined plane D, will be found.

EXAMPLE II. Fig. 42.

SUPPOSE the object C near some inclined plane G, whose shadow falls upon it. To find the shadow, draw a line b to G, parallel to the ground line, at pleasure; draw then a ray, as before, cutting at G, where the shadow would have terminated if the inclined plane had not been there; draw $m l$ parallel to $n o$, cutting the ray at p ; do the same at the other end, and the shadow will be completed.

Before I enter upon the other cases of shadows, I would here remark, that this which has now been exemplified is, in my opinion, the most useful, as well as most easily practised. Particularly it is the most useful to the cabinet-maker and upholsterer, who only want it for shading different pieces of furniture; because the shadows thus projected will be to the right or left of the piece, according as the light is supposed to come in; but in the two following cases of the sun's rays, the shadows will be projected either behind, or on the front of the piece of furniture, which situations of shadow are liable to the following objections.

First, if the rays come from behind the picture, the front of the piece will be all in shadow, and consequently the effect of distinctness of parts, which is always expected in furniture, will be destroyed.

Secondly, if the rays come on the front, then the shadow will be behind the piece, and therefore little or none of it will be seen, unless the point of light be taken very low, which is not very agreeable. Besides, the light coming thus strong on the piece, leaves a glare on the front that does not produce a pleasing effect in furniture, nor sufficiently distinguishes the front from the white ground of paper on which it is generally drawn.

Painters, indeed, are said to make this last-mentioned position of light to the picture their choice, because, I suppose, it clears their picture from the appearance of long black shadows, which would frequently look too harsh, and introduce confusion, as is the case when the light comes in from behind. Yet as every case of shadowing may be necessary at times, though not out of choice, I shall therefore proceed to the second case proposed.

CASE II. FIG. 43. Plate XXVI.

To project the Shadows of Objects when the Rays come in a Direction from behind the Picture.

WHEN a ray of light comes in a direction not parallel to the picture, it will necessarily cut it in some point in the horizontal line, or vanishing line of the ground plane; for the sun being at an immense distance, and the plane of the horizon being considered as infinitely extended, we may suppose a perpendicular let fall from the place of the sun will touch somewhere on the horizon. And hence, the point where it touches the horizon is the vanishing point of the shadows, and consequently a line drawn through the said point perpendicular to the horizon will be the vanishing line of the sun's rays; and any where on this line, if a point be fixed according to the supposed altitude

altitude of the sun, it will be the vanishing point of those rays.

Thus:—in Fig. 43, the center and distance of the picture remaining the same as when used for drawing the cube, let it be required to find its shadow when the sun's inclination to the left is thirty-two degrees, and when its altitude is forty-five. From d , the distance, draw the line db , inclining from the perpendicular sd in an angle of thirty-two degrees; and through b draw SS perpendicular to the horizon; then will SS be the vanishing line for the sun's rays. Make bM equal bd , and from M draw MS , making an angle with the horizon equal to forty-five degrees; then will S above the horizon be the vanishing point of the rays when the sun comes from behind the picture, and S below it will supply its place when the rays come on the front. From the vanishing point b of the shadow draw lines through the angles 1, 3, 8, of the cube; and from S draw lines through its upper angles 2, 4, 9, intersecting the lines drawn from b in the points 5, 6, 10; from the point 5 draw a line to 6, and from 6 a line to 10, which completes the shadow.

Observations on the Theory of the above Figure.

THE rays $S6$ and $S10$, forming a triangle, may be considered as a plane of rays passing by the angle 4, 9 of the cube,
and

and being flopped on the ground plane at 6, 10, occasions a shadow up to the cube, which shadow will vanish in the line 6, 10, to V; because the angle or line 4, 9, which projected it, was drawn to, and vanishes in V; consequently a line from V to S, the supposed place of the sun, will be the vanishing line of the said plane of rays. The shadow on the other side is composed of two lines, because it is projected by two lines in different positions to each other. Thus the line 2, 4, originally parallel to the horizon and to the ground, projects the shadow line 5, 6 by the plane of rays 5, S, 6; which shadow line 5, 6 will vanish in V, because the angle or line 2, 4 vanishes there. The shadow line 5, 1 is projected from the perpendicular line 1, 2 by the plane of rays 5, b, S, passing by the angle or perpendicular line 1, 2, and therefore the shadow line 5, 1 will vanish in b, the seat of the luminary on the picture; through which a line SS passing in a perpendicular direction to the horizon, answerable to the perpendicular sides of the cube, is the vanishing line of the plane of rays 5, S, b, in the same manner, and for the same reason, as the horizontal ψ V is the vanishing line of the shadows of lines originally parallel to it. The vanishing line SS of the sun's rays may be supposed to move along the horizon answerable to the sun's inclination to the right or left of the center of the picture s, whether the sun be supposed on this or that side of the picture, or, as we conceive of it by the figure, whether it be above or below the horizon. Hence, if a plane
of

of rays be supposed to come from behind the picture, in a direction perpendicular to it, the place of the sun will be somewhere on a perpendicular line drawn through the center of the picture, as Sd . And this place of the sun, or, which is the same thing, the vanishing point S , of its rays, will be above or below the horizon, according to the supposed altitude of the sun. If, therefore, we imagine the sun's altitude to be as before, its place will be at d when the sun is behind the picture, and at S when it is before it; and the vanishing point of the shadow will be at s , the center of the picture. This is evident, for the angle V, d, s , is the same and equal to M, S, b . In both cases the sines bS, od , of the angles of the sun's altitude are the same, being equal to the distance sV of the picture: for, in the shadow of the cube, when the plane of rays from behind the picture cut it in the oblique direction of the line db , the line db is then considered as the distance of the picture, and being turned up to S , is equal to the distance of the place of the sun above the horizon. And suppose the rays to come to the picture in the direction of dv , then b would be moved to v , and vd would be equal to the distance of the picture; and being turned up to vS , S would then be the place of the sun, or the vanishing point of its rays, and v the vanishing point both of the shadow and side of the cube 2, 4. In which case we should only have the shadow of the side 4, 9, 3, 8.

It is further observable, that as the sun may be supposed to move in a circle, and if that circle be described by a radius equal to the distance of the picture, we may show the different shadows of the sun upon objects at the various times of the day.

Thus:—in Fig. 44, suppose a line drawn from EW forming the horizon; from the center *s* describe a circle with the distance of the picture, and through *s* draw a line perpendicular to the horizon, and *M* will be the place of the sun at noon. Now let it be required to find the morning shadow of the rod *a* when the sun has risen 40 degrees above the horizon, as at 40° S. From 40° S let fall a perpendicular to the horizon at *b*, and draw it through to the other semicircle; from *b*, the vanishing point of the shadow, draw lines passing by the bottom of the rod at pleasure; and from 40° S, the place of the sun, draw a ray through *a*, the top of the rod, cutting at *r*; which shews the length of the shadow required. Suppose the shadow of the same rod be wanted at noon, *s* will then be the vanishing point of the shadow, and *M* the vanishing point of the sun's rays, and the length of the shadow will be at 5. Again, if it be required to find the shadow of the same rod after the sun has passed the meridian 50 degrees, this will bring the sun to the same degree in the afternoon as it was in the morning; and by drawing lines

in

in the same manner as in the morning, the shadow in the afternoon will be at 2.

Now, if the sun be considered on this side the picture, the shadows of the same rod *a*, at these different periods of the day, will be respectively beyond the rod at 3, 4, 6, towards the horizon; which is done by transprojecting the place of the sun to S M S, and drawing rays from the top of the rod to each place of the sun. Thus: from *a* draw the dotted line to S on the left, cutting at 3, and 3 will be the length of the morning shadow; and from *a* draw the dotted line to S on the right, cutting at 4, which will be the evening shadow. Lastly, a dotted line from *a* to M, cutting at 6, will be the shadow at noon, which is hardly seen on the picture. Thus we see that the shadows of a morning or evening view are long, tending opposite ways; and those of a view representing noon-day are short, tending from south to north, nearly so. But if we lived in a meridian on the line, then it is evident that at noon there would not be the least shadow of objects of equal thickness standing perpendicular on the ground: for, suppose the rod *a* moved into the line M M, then the object would be in the same plane with the rays of the sun; and being directly under it, of course all shadow would be excluded excepting suspending objects, as No. 2, and those supported like tables; in which case the rays *r r* falling perpendicular to the

U u 2

ground

ground, and parallel to each other, on account of the sun's great distance, they would form a cylinder, of which the shadow would be a parallel section, and therefore must be perfectly similar to the object itself, both in magnitude and form, as must be evident from the figure, and a little reflection on the foregoing principles.

CASE III.

To find the projections of Shadows when the Sun's Rays come on the Front of the Picture.

HAVING already explained the theory of this in what has now been advanced, it remains only to give an example or two to illustrate it.

EXAMPLE I. FIG. 45. Plate XXVI.

When the Shadow falls on the Ground.

IN Fig. 45, A is a prism whose shadow is projected by the sun as above proposed, *b* is the vanishing point of the shadow, *v* of the side of the cube, and *S* of the rays. Therefore from the angles 1, 2, 3, draw lines to *b*; and from 4, 5, 6, at the top, corresponding with these, draw lines to *S*, cutting at *g*, *c*, *b*;

from *b* draw a line to *c*, and from *c* to *g*, which, when filled up, will complete the shadow.

EXAMPLE II. FIG. 46. Plate XXVI.

When the Shadow falls at the same Time on upright, oblique, and horizontal Planes.

THIS figure having the most necessary lines for representing the two houses, as well as for finding the shadow of one house falling upon the other, may be considered as an example both of perspective and of shadow. And as the lines for both are here joined together in one view, it will shew their relation, and the necessary dependence they have on each other; which, it is presumed, will contribute more to the learner's advantage, than if many examples of shadowing had been added without regard to the perspective lines.

The horizon and ground line being drawn, fix the center of the picture as usual; from which raise a perpendicular as to *d*. Make *d* the distance of the picture, and, according to the obliquity suitable for the front of the house, draw a line to *V*, for one vanishing point; next draw *V d*, and from *d* draw a line to *v*, at right angles with *V d*; because the end and front of the house are originally at right angles to each other. Make *v M* equal to *v d*, and whatever angle the pitch of the roof makes, produce

produce a line from *M* equal to that angle, continued till it cut a line perpendicular to *v*, as at *V*; then is *V* the vanishing point for the side of the roof of both houses, and a line from *V* to *V* will be the vanishing line of the plane which the roof is in, and *H* will be the vanishing point of shadows lying in the said plane; and producing *VV* at pleasure, and meeting it in *o* at Fig. 44, by a parallel from *S*, *o* will be the vanishing point of the sun's rays on that plane. Extend the compasses from *V* to *v*, and place it below the horizon; and that point will serve for the other side of both roofs. The houses being completed in their outlines, according to these vanishing points, proceed to shade them upon a supposition that the light comes on in the front of the picture, and in a direction from the left hand parallel to the dotted line *db*. Therefore the point *b* will be the vanishing point of the shadows falling upon the ground plane, and producing *b* perpendicular to the vanishing line *VV*, *H* will be the vanishing point as aforesaid. The place of the sun *S* is fixed very low, not as a precedent, but that it might throw the shadow of the first house on the second, affording an occasion of shewing the nature of such shadows.

From *g*, the pitch of the roof on the gable-end, draw a line to *S*; and from *a* draw a line to *b*, which will cut the front of the other house at *o*; from *o* raise a perpendicular, cutting the line drawn from *g* to *b* in *e*; from *e* direct a line to *V*, the vanishing

nishing point for the fronts of each house, which gives the shadow for the roof. From the tops of each chimney draw lines to S, and observe that the shadow of the first chimney falls partly on the roof, because the ray drawn to S cuts the roof, and that ray must be cut again, by drawing a line from the top of the perpendicular shadow *o e* to H, the vanishing point of such shadows as fall on the roof, and from the top of the shadow on the roof direct a line to *o*, in Fig. 44, which gives the complete shadow of the chimney. Lastly, from *b*, at the bottom of the second house, draw a line to *h*; and cut that line by two others, one from the top of the chimney, and another from the pitch of the roof, as before; from these intersections draw lines to V, the vanishing point of the house, and the shadows will be finished.

Of Shadows when the Sun is not supposed to shine, or those produced by common Light.

AFTER what has been said on shadows produced by the sun, it will not be requisite to say much on this head. It will, however, admit of a few remarks.

And first, suppose an object *a, b, c*, Fig. 47, placed to the light, and consider the parallel lines as rays of common light falling on it; for common light directs its course to ob-
jects

jects in this manner. Now it is evident, moreover, that the side or plane *a* will have most of the light, because the rays fall nearly perpendicular on it, which consequently excludes all shadow; but the plane or side *b* receives the said rays obliquely, and in proportion thereto occasions a shadow, because the light partly misses the surface. The plane *c* is totally in shadow, because the ray *r* cannot touch that surface.

Secondly, in shadows of this kind the contrast of light and shade is not so strong, as when the sun's rays fall on objects; the light is not so glaring, nor the shadows so black. The outlines of such shadows ought not to be strongly defined, but faint, and sometimes indistinct, especially when the light is supposed to come from different apertures.

Lastly, such objects as are supposed to be viewed in a room have their upper parts lightest; but the lightest parts will bear a tint, and sometimes considerable, so that there will not be much opposition of light and shade in their different surfaces.

It is requisite to consider the natural colours of objects, in order to fix the tone and true scale of light suitable to them *. The lightest part of an object that is of itself black, would be

* This is also necessary when the sun is supposed to shine.

a shade to one that is white, and therefore, in producing a shadow to any thing black or blue, it will require all the force and strength of the Indian ink. The other colours, as green and yellow, &c. will also require a due degree of light and shade to distinguish them by.

Mr. Kirby considers the colours receding from white to black in the following order: *i. e.* yellow after white, then green, red, blue, and black, successively. It is difficult, however, to distinguish some of these by the effect of Indian ink, yet it is evident something may be done towards it. Thus: the cube W is supposed to be white, Y yellow, G green, R red, B blue, and BL black*.

Of the Proportion of Tints suited to Objects at different Distances in the same Picture. See a View, Plate XXVI.

It is evident, from the nature of perspective in general, that not only the proper dimensions of objects, but also the degree of tint, is essential in making them appear at different dis-

This is not the order of the simple colours, according to Sir Isaac Newton's theory of their origin. His theory informs us, that when the rays of light are separated by the refraction of a prism, the first will be red, then orange, yellow, green, blue, indico, and violet, successively. See his Optics, Book I. Prop. 6. According to this, white is not a simple colour, but a compound or mixture of all that are simple, and black a total privation of every colour.

tances. For, as in linear perspective, objects are viewed under a smaller angle in proportion as they are at a distance, so in the aerial part every tint and shadow gradually weakens as the object is situated at a distance from the front of the picture. The reason of this is obvious, when it is admitted that we are made to see objects by innumerable beams of light issuing from them to the eye. It is easy then to conceive, that when these beams or rays of light have to make their way through the air from distant parts of the horizon to the eye, they must greatly weaken before their arrival to it, and therefore such distant objects must appear less distinct and more dim in proportion to that distance. Hence, in a picture, as in the view given in Plate XXVI. objects on the fore ground are not only larger, but they are more made out, more distinct, and strongly marked. Their lights are brighter, and their shades are darker, than those on the back ground. This will, perhaps, be more easily understood by the following observations on the view.

The tree on the left is nearest to the eye of the spectator, and is therefore most made out; its leaves are seen in clusters, and its shade is strong.

The first tree on the right, being further back, is less distinct in its parts, and rather fainter in its shadows; and so of the rest in proportion to their distance.

With

With respect to the houses, we see the second weaker in its parts, and its shadow, partly on the water and on the ground, fainter than that of the first. The last house being at a vast distance, appears as one mass without distinction of parts; and thus objects diminish off till they and the horizon on which they stand mix with the sky.

Of the reflected Images of Objects, on Water.

To ascertain the reflected images of objects on water is exceeding easy, and very essential to some pictures. It is a law in catoptrics*, that the angle of reflection is always equal to the angle of incidence †.

The angle of incidence and reflection may be thus understood and distinguished. The inclined post, and its shadow on the water, form an angle with each other; and at the bottom of the post, where the line of reflection on the water and the line

* Catoptrics, from *κατοπτρα*, *katoptron*, a mirror or looking-glass. Catoptrics teach the science of reflex vision, and optics that of direct vision, though in the general and extensive meaning of the term optics, “from *ὀψωμαι*, *optomai*, I see,” it includes in it “whatever relates to sight, or the doctrine of vision;” and therefore must imply dioptrics also, which teaches the properties of refracted vision; that is, when rays of light pass through one medium into another, as air and water.

† See second axiom of Sir Isaac Newton's Optics.

of incident rays from the post meet, that point is termed the point of incidence; and if from the top of the post a perpendicular be let fall, it will form a triangle; and if that triangle be bisected; that is, by drawing a parallel line from the point of incidence b , cutting the perpendicular at c , then the angle c, a, b , is the angle of incidence; and c, d, b , the angle of reflection, which are equal. Therefore if an object be perpendicular to the horizon, its reflected image on water will also be perpendicular, but in an inverted position to the object which reflects the image. And whatever angle of obliquity any object makes with the ground, the same will be its reflection to the surface of the water.

The reflections of images on water are the same as those in a plain mirror. The surface of the mirror or looking-glass is the plane of reflection; and it is evident, that in whatever position any object is presented to it, the same will be that of its reflection on the said plane. 'If a rod, &c. be placed perpendicular to the mirror, its reflected image will be perpendicular to it also. And if one end of it touch the glass, its image will also appear to touch the surface of it; or if it is withdrawn, its image will appear equally removed from the reflecting plane. This experiment is within the reach of every one, and will be sufficient to convince any of the truth of the above proposition.

EXAMPLE I. See the View, Plate XXVI.

IF, therefore, the reflection of the inclined post be wanted, let fall a perpendicular at pleasure, and cut that perpendicular by a line drawn from the bottom of the post inclining to the said perpendicular in an angle equal to the object, and it will give the length and inclination of the reflected image. And observe, that the length of the reflection on the water will be in proportion to the distance of the object from it; consequently if the post were removed a little further from the edge of the water, we should lose its reflection entirely.

EXAMPLE II.

IF it be required to find the reflection of any of the trees supposed to stand nearly perpendicular, let fall a perpendicular from the bottom of it, and take the whole height of the tree and place it downwards from the bottom of it, then take the length of the trunk and do likewise, which will give the reflection as required.

Lastly,

Lastly, it is manifest from these principles, that if any object be floating in the water, such as a piece of timber or a ship, that its reflected image will be equal in length to the object itself, and the depth of the reflection below the surface of the water will be equal to the height of the object above it.

END OF THE SECOND PART.

THE
CABINET-MAKER AND UPHOLSTERER'S
DRAWING-BOOK.

PART III.

CONTAINING A DESCRIPTION OF THE SEVERAL PIECES OF FURNITURE. 1. OF THE USE AND STYLE OF FINISHING EACH PIECE. 2. GENERAL REMARKS ON THE MANUFACTURING PART OF SUCH PIECES AS MAY REQUIRE IT. 3. AN EXPLANATION OF THE PERSPECTIVE LINES WHERE THEY ARE INTRODUCED. TO WHICH IS ADDED, A CORRECT AND QUICK METHOD OF CONTRACTING AND ENLARGING CORNICES OR OTHER MOULDINGS OF ANY GIVEN PATTERN.

INTRODUCTION.

THE design of this Part of the Book is intended to exhibit the present taste of furniture, and at the same time to give the workman some assistance in the manufacturing part of it.

I am sensible, however, that several persons who have already encouraged the work, will not want any help of this,

nature; but it is presumed many will who are not much conversant in the business, and who have had no opportunity of seeing good pieces of furniture executed.

For the advantage of such, it is hoped that the experienced workman will exercise candour and patience in reading the instructions intended, not for himself, but for those now mentioned.

There are few but what may, with propriety, reflect on their own past ignorance, even in things which afterwards become exceeding simple and easy by a little practice and experience. Such a reflection ought, therefore, to promote both candour and good nature in the minds of proficients, when they read the documents necessary to young beginners. And yet, I hope, it may be said, without arrogance, that it is probable the experienced workman may derive some information from the subsequent remarks, when it is considered that they are made not merely from the knowledge and experience I have myself of the business, but from that of other good workmen.

In conversing with cabinet-makers, I find no one individual equally experienced in every job of work. There are certain pieces made in one shop which are not manufactured in another, on which account the best of workmen are sometimes
strangers

strangers to particular pieces of furniture. For this reason I have made it my business to apply to the best workmen in different shops, to obtain their assistance in the explanation of such pieces as they have been most acquainted with. And, in general, my request has been complied with, from the generous motive of making the book as generally useful as possible.

The methods therefore proposed, and the remarks made, may be depended on by those who have not yet had an opportunity of seeing the different pieces executed.

This is an attempt which has not yet been made in any book of cabinet designs, except a very few slight hints; and, though it must be acknowledged by every impartial mind as highly useful, and even in some cases absolutely necessary, yet I am apprehensive it will not meet with the approbation of those who wish to hoard up their own knowledge to themselves, lest any should share in the advantage arising from it. In some instances it may be necessary for a man to keep knowledge to himself, as his own property, and upon which his bread may depend; but I do not see any impropriety in persons of the same branch informing each other. In trades where their arts depend on secrets, it is right for men to keep them from strangers; but the art of cabinet-making depends so much on practice, and requires so many tools, that a stranger cannot

steal it. But in every branch there are found men who love to keep their inferiors of the same profession in ignorance, that themselves may have an opportunity of triumphing over them. From such I expect no praise, but the reverse. Their pride will not suffer them to encourage any work which tends to make others as wise as themselves; and therefore it is their fixed resolution to despise and pour contempt upon every attempt of this kind, in proportion as it is likely to succeed. But those I will leave to themselves as unworthy of notice, who only live to love themselves, but not to assist others.

Here I would beg leave to observe, that it is natural for every man under a heavy burden to pour out his complaint to the first sympathizing friend he meets with. If the reader be one of these, I will pour out mine, by informing him of the difficult task I have had to please all; and to suit the various motives which different persons have for encouraging a publication like this.

I find some have expected such designs as never were seen, heard of, nor conceived in the imagination of man; whilst others have wanted them to suit a broker's shop, to save them the trouble of borrowing a basin-stand to shew to a customer. Some have expected it to furnish a country wareroom, to avoid the expence of making up a good bureau, and double chest of drawers,

drawers, with canted corners, &c. and though it is difficult to conceive how these different qualities could be united in a book of so small a compass, yet, according to some reports, the broker himself may find his account in it, and the country master will not be altogether disappointed; whilst others say many of the designs are rather calculated to shew what may be done, than to exhibit what is or has been done in the trade. According to this, the designs turn out to be on a more general plan than what I intended them, and answer, beyond my expectation, the above various descriptions of subscribers. However, to be serious, it was my first plan, and has been my aim through the whole, to make the book in general as permanently useful as I could, and to unite with usefulness the taste of the times; but I could never expect to please all in so narrow a compass: for to do this, it would be necessary to compose an entire book for each class of subscribers, and after all there would be something wanting still.

A DESCRIPTION OF THE SEVERAL PIECES OF FURNITURE.

Of the Universal Table. Plate XXV. of the Cabinet Designs.

THE use of this piece is both to answer the purpose of a breakfast and a dining-table. When both the leaves are flipped under the bed, it will then serve as a breakfast-table; when one leaf is out, as in this view, it will accommodate five persons as a dining-table; and if both are out, it will admit of eight, being near seven feet long, and three feet six inches in width.

The drawer is divided into six boxes at each side, as in the plan, and are found useful for different sorts of tea and sugar, and sometimes for notes, or the like. In this drawer is a slider lined with green cloth to write on. The style of finishing them is plain and simple, with straight tapered legs, socket castors, and an astragal round the frame.

Of the manufacturing Part.

This table should be made of particularly good and well-seasoned mahogany, as a great deal depends upon its not being

liable to cast. In the best kind of these tables the tops are framed and pannelled; the bed into two pannels, and the flaps each into one, with a white string round each pannel to hide the joint. The framing is three inches broad, and mitered at the corners; and the pannels are sometimes glued up in three thicknesses, the middle piece being laid with the grain across, and the other two lengthways of the pannel, to prevent its warping. The pannels are, however, often put in of solid stuff, without this kind of gluing.

When the pannels are tongued into the framing, and the miters are fitted to, the tops should stand to shrink as much as possible before they are glued for good. There are different methods of securing the miters of the framing. Some make simply a straight miter, which they can shoot with a plane; after which they put a couple of wooden pins in. Others, again, having fitted the miters to by a plane, they slip in a tenon. But the strongest method is to mortice and tenon the miters together, having a square joint at the under, and a miter joint at the upper side. This method, however, is the most tedious of the three, and where the price will not allow of much time, the above methods are more ready, and, if managed with care, are sufficiently strong. In gluing the miters, it will be proper, first, to glue on the outside of each miter a piece of deal in the shape of a wedge, which will take a hand-screw, so that when they

they are putting together, the glue may be brought out, and the miters made close.

The frame, as shewn in the plan, is made exactly square, either of faulty mahogany, or of wainscot veneered. In making this frame a box is formed at each end, about three inches in width, containing two sliders apiece, which run past each other in the said box, as shewn in the plan. In the bottom of each box are put two pieces, with plough grooves in them, and raking contrary to each other. In the line NO, on those raking pieces the sliders run, and are stopped from coming too far out by a pin fixed in the under edge of the slider; which pin runs in the plough grooves already mentioned, denoted in the plan by a dark line. The raking line of the sliders is found by taking the width of the flap, as from S to M, and making the line incline in that width equal to the thickness of the flap. This may be easily understood, by placing a rule from the outer point M of the flap, to S the inner point, which then will be parallel to the raking line. The sliding pieces being in a right line their whole length at the under edge, of course their upper edge must be bevelled off, so that when they are drawn fully out, they may be even, and in an exact line with the top of the frame.

The frame and tops being thus prepared, they are connected together by an iron screw and nut, as at A, which is
about

about the substance of a bed-screw. This screw is jointed into a plate, which plate is let into the under side of the bed, level with it; though I have described it at A with its thickness out, merely that the plate might be shewn. At B the bed A is represented on the frame, and the iron screw passing through the rail of the table, is confined to its place by the nut, which is let into the under edge of the rail by a center-bit. And observe, in making this center-bit hole for the nut, it must be sunk deeper than its thickness, that the bed may have liberty to rise a little, and so give place to the flaps when they are wanted to be pushed in. It must be noticed also, from the plan of the frame, that there is a middle piece, about five inches broad, and of equal thickness with the flaps, screwed down to the frame with four screws at each end. This middle piece answers three purposes; it secures the frame, stops the flaps when they are pushed in, and prevents the sliding pieces from tilting.

Before the bed is finally fixed to its place, there must be four pieces of green cloth let into the under side of it, to prevent the flaps from rubbing as they slide under. Upon the edges of the flaps a hollow is worked all round, leaving a quarter of an inch square, for no other purpose than to take off the clumsy appearance of the two thicknesses when the flaps are under

under the bed. At the under side of the flaps must be goged out finger-holes, to draw them out by.

The drawer is next to be considered, which is sometimes made with two fronts, and to draw out both ways, as in the plan. On each front of the drawer is a lock, for the convenience of securing it at either end; for in case one flap be drawn out, then the drawer can be locked or pulled out at the contrary front, without the trouble of pushing the flap in to come at the drawer.

The covers of each box before mentioned, may have an oval of dark wood, and the alphabet cut out of ivory or white wood let into them, as in the plan; or they may be white ovals and black letters; the use of which is to distinguish the contents of each box.

Lastly, the slider to write on is made exactly half the inside length of the drawer; so that when it is pushed home to either front, there is immediate access to six of the boxes.

And here I would observe, that sometimes the flaps of these tables have round corners, but they do not answer the bed so well when they are in. And, to save expence, the tops have been found to answer the purpose in solid wood, without being framed.

framed. When they are made in this manner, particular regard should be had to placing the heart side of the wood outward, which naturally draws round of itself, and may therefore be expected to keep true, notwithstanding its unfavourable situation.

N. B. The heart side of a board is easily known by planing the end, and observing the circular traces of the grain, which always tend outwards.

The Perspective Lines explained.

IN making designs in perspective, the first thing to be attended to is the scale of feet and inches, by which to proportion the different parts to each other, to determine the height of the horizon, and the distance of the picture.

Having made the scale, take from it about five feet six for the height of the horizon at H L. On this line place the point of sight, so as to give the most favourable view of the design, as at *s*. Next lay on the distance, which is here out of the plate, and being equal to the space *s a*, agrees to the rule for choosing a distance contained in page 281. Draw *a b* perpendicular to the ground line, and from *a* draw a line to the point of sight *s*.

Next consider how much the top projects over the frame, and as much as this is, lay it from a towards e , as the first line shews, which is directed to the point of distance. Where this cuts the aforefaid line drawn to s , raise a perpendicular answering to $a b$. From b lay on the space $b d$, for the depth of the framing; and from d draw a line as before to s ; and from where the line cuts the second perpendicular, draw a parallel for the under edge of the framing. On a parallel line from b , lay on the dimensions of the bed and flap; and from these draw lines to s , as the design shews. Now, as the bed of the table is square, nothing more is wanted to find its apparent width than to draw a line from o to the distance which cuts at the opposite angle; and through this angle draw $r t$ parallel, which completes the out-line of the top.

To find the place of the drawer and the boxes in it, proceed thus.—On the ground line make $a o$ equal to the whole space, from the drawer in the plan to the projection of the middle piece across the frame. Also make $e b$ the whole length of the drawer, and $g f$ the divisions for the boxes. From each of which draw lines to the distance, cutting at 1, 2, 3, 4; from which draw parallels to 7, 6, 5, 8. Again, from 7 raise a perpendicular, and make $k b$, on $k m$, equal to the height of the drawer; from b draw a line to s ; and from m , the height of the covers of each box, do the same. Lastly, from 6, 5, &c.

raise perpendiculars, which will cut *bs* in the place for the boxes, and at *n* for the height of the covers. How every other thing is done, must be obvious from inspection.

Of the Sideboard Tables, Plate XXVI. and XXIX. and of Tables of this Kind in general

THE sideboard in Plate XXVI. has a brass rod to it, which is used to set large dishes against, and to support a couple of candle or lamp branches in the middle, which, when lighted, give a very brilliant effect to the silver ware. The branches are each of them fixed in one socket, which slides up and down on the same rod to any height, and fixed any where by turning a screw. These rods have sometimes returns at each end of the sideboard; and sometimes they are made straight, the whole length of the sideboard, and have a narrow shelf in the middle, made of full half-inch mahogany, for the purpose of setting smaller dishes on, and sometimes small silver ware.

The right-hand drawer, as in common, contains the cellaret, which is often made to draw out separate from the rest. It is partitioned and lined with lead, to hold nine or ten wine bottles, as in Plate XXIX.

The drawer on the left is generally plain, but sometimes divided into two; the back division being lined with baize to hold plates, having a cover hinged to enclose the whole. The front division is lined with lead, so that it may hold water to wash glasses; which may be made to take out, or have a plug-hole to let off the dirty water. This left-hand drawer is, however, sometimes made very short, to give place to a pot-cup-board behind, which opens by a door at the end of the side-board. This door is made to hide itself in the end rail as much as possible, both for look and secrecy. For which reason a turn-buckle is not used, but a thumb-spring, which catches at the bottom of the door, and has a communication through the rail, so that by a touch of the finger the door flies open, owing to the resistance of a common spring fixed to the rabbet which the door falls against, as is denoted by the figure A. F is for the finger, B is the brass plate let into the rail, L is the lever, *p* is the spring that presses the lever upwards, and *c* is the end of it which catches the under edge of the door as it passes over it and strikes into a plate with a hole in it, and *s* is the spring screwed to the rabbet which throws the door out when F is pushed upwards.

But the reader must here observe, that the shape of this sideboard will not admit of a cupboard of this sort in the end rail.

rail. Those which are square at the ends, and only a little shaped in front, are fittest for this purpose.

In large circular sideboards, the left-hand drawer has sometimes been fitted up as a plate-warmer, having a rack in the middle to stick the plates in, and lined with strong tin all round, and on the underside of the sideboard top, to prevent the heat from injuring it. In this case the bottom of the drawer is made partly open, under which is fixed a small narrow drawer, to contain a heater, which gives warmth to the plates the same as in a pedestal.

In spacious dining-rooms the sideboards are often made without drawers of any sort, having simply a rail, a little ornamented, and pedestals with vases at each end, which produce a grand effect. One pedestal is used as a plate-warmer, and is lined with tin; the other as a pot-cupboard, and sometimes it contains a celleret for wine. The vases are used for water for the use of the butler, and sometimes as knife-cases. They are sometimes made of copper japanned, but generally of mahogany.

There are other sideboards for small dining-rooms, made without either drawers or pedestals; but have generally a wine-cooper to stand under them, hooped with brass, partitioned and lined with lead, for wine bottles, the same as the above-mentioned celleret drawers.

The

The sideboard in Plate XXIX. shews two patterns, one at each end. That on the left is intended to have four marble shelves at each end, inclosed by two backs, and open in front. These shelves are used in grand sideboards to place the small silver ware on. The pattern on the right is intended to have legs turned the whole length; or rounded as far as the framing and turned below it, with carved leaves and flutes. The division beyond the celleret-drawer is meant for a pot-cupboard.

It is not usual to make sideboards hollow in front, but in some circumstances it is evident that advantages will arise from it. If a sideboard be required nine or ten feet long, as in some noblemen's houses, and if the breadth of it be in proportion to the length, it will not be easy for a butler to reach across it. I therefore think, in this case, a hollow front would obviate the difficulty, and at the same time have a very good effect, by taking off part of the appearance of the great length of such a sideboard. Besides, if the sideboard be near the entering door of the dining-room, the hollow front will sometimes secure the butler from the jostles of the other servants.

Of the Perspective Lines.

HAVING drawn the plan and adjusted the height of the horizon by the scale, as was mentioned in the universal table, represent a parallelogram *a, b, c, d*, equal to the length and breadth of the table; and from every part of the plan draw lines up to the ground line, and from the ground line direct these to the point of sight. Take from the plan the space *MN*, and place it from 1 to 2; and from 2 direct a line to the point of distance, cutting a point next to *y*; from which point draw a parallel for the place of the front legs. In like manner take the other dimensions from the plan to find every other correspondent point in the representation. To find the representation of the hollow and round fronts, consult the treatise on perspective in pages 294 and 295, together with the lines here shewn as hints, and it is presumed that the learner will not be at any loss in drawing such a table.

Of the Book-case Doors. Plate XXVII. and XXIX.

IN the execution of these doors, the candid and ingenious workman may exercise his judgment, both by varying some parts of the figures, and taking other parts entirely away, when the door is thought to have too much work.

No. 1, in Plate XXVII. might do for a plain door, if the ornament and square part in the middle were taken away.

No. 2 might also have the square in the middle taken away, and look very well.

No. 4 may have the upright and horizontal bars away, and No. 5 the small squares; and at each angle of the hexagon the straight bar might be carried through to the frame.

With respect to No. 6, it may be useful to say something of the method of making it, as well as of some of those in Plate XXIX.

The first thing to be done, is to draw, on a board, an oval of the full length and breadth of the door. Then take half the oval on the short diameter and glue on blocks of deal at a little distance from each other, to form a caul; then, on the short diameter, glue on a couple of blocks, one to stop the ends of the veneer with at the time of gluing, and the other, being bevelled off, serves to force the joints of the veneer close, and to keep all fast till sufficiently dry. Observe, the half oval is formed by the blocks of the size of the astragal, and not the rabbet; therefore consider how broad a piece of veneer will make the astragals for one door, or for half a door. For a whole door, which
takes

takes eight quarter ovals, it will require the veneer to be inch and quarter broad, allowing for the thickness of a fash saw to cut them off with. Veneers of this breadth may, by proper management, be glued quite close; and if the veneer be straight banded, and all of one kind, no joint will appear in the astragal. Two half ovals thus glued up, will make astragals for a pair of doors, which, after they are taken out of the cauls and cleaned off a little, may be glued one upon the other, and then glued on a board, to hold them fast for working the astragals on the edge; which may easily be done, by forming a neat astragal in a piece of soft steel, and fixing it in a notched piece of wood, and then work it as a gage; but before you work it, run on a gage for the thickness of the astragal; and after you have worked the astragal, cut it off with a fash saw, by turning the board on which the sweep-pieces are glued on an edge; then having sawn one astragal off, plane the edge of your stuff again, and proceed as before.

For gluing up the rabbet part, it must be observed, that a piece of dry veneer, equal to the thickness of the rabbet, must be forced tight into the caul; and then proceed as before in gluing two thicknesses of veneer for the rabbet part, which will leave sufficient hiding for the glass, on supposition that the astragal was glued in five.

The door being framed quite square, without any moulding at the inner edge, proceed to put in the rabbet pieces. Put, first, an entire half oval, and screw this to the inner edge of the door, and level with it; then jump up the other half oval to it, and screw it as before; which completes the center oval. Next, fix the square part, having been before mitered round a block, and keyed together; after which, half-lap the other quarter ovals into the entire oval where they cross each other, and into the square part, liping it into the angle of the door; put in the horizontal bars for the leaves to rest on; glue on the astragals, first on the entire oval, tying it with pack-thread, to keep it on; then the straight one on the edge of the framing, fitting it to the oval; lastly, miter the astragal on the square part, and every other particular will follow of course.

With respect to the doors in Plate XXIX. all of them may be made nearly on the same principles, at least the rabbet parts must; but the astragals in No. 1, being all of them portions of circles, should be cut out of solid wood, and glued on a deal board and sent to the turner's. The same may be said of No. 5, which, in the vase part, may have a piece of silvered glass. The center in No. 2, is intended to have a print or painting in it. The sweeps, in No. 6, should be cut out of the solid, and worked by a tool. As to fixing any part of the ornaments introduced in these doors; this is easily done, by preparing a
 very

very strong gum, which will hold on glass almost as strong as glue on wood.

Of the Secretary and Book-case. Plate XXVIII.

THE use of this piece is to hold books in the upper part, and in the lower it contains a writing-drawer and clothes-press shelves. The design is intended to be executed in satin-wood, and the ornaments japanned. It may, however, be done in mahogany; and in place of the ornaments in the friezes, flutes may be substituted. The pediment is simply a segment of a circle, and it may be cut in the form of a fan, with leaves in the center. The vases may be omitted to reduce the work; but if they are introduced, the pedestal on which the center vase rests is merely a piece of thin wood, with a necking and base moulding mitred round, and planted on the pediment. The pilasters on the book-case doors are planted on the frame, and the door hinged as usual. The top of the pilasters are made to imitate the Ionic capital.

Of the Perspective Lines.

GR is the ground line, and HL the horizontal line, or height of the eye. Lay on the original heights of the book-

case, as at *g, b, i, j, k*, &c. and draw a perpendicular line at the angle of the piece, as at *A*; to which direct parallel lines as shewn. On the ground line lay *a*, or two feet, for the breadth of the end; and from *b a* direct lines to the distance, which is here out of the plate, cutting the visuals at *d e*; from *e* raise a perpendicular, which will determine the front of the book-case, provided it be only a foot deep. The perpendicular *B* is necessary, in order to find the perspective heights of the book-case, as shewn in the figure.

Of the Library Table. Plate XXX.

THIS piece is intended for a gentleman to write on, or to stand or sit to read at, having desk-drawers at each end, and is generally employed in studies or library-rooms. It has already been executed for the Duke of York, excepting the desk-drawers, which are here added as an improvement.

The style of finishing it ought to be in the medium of that which may be termed plain or grand, as neither suits their situation. Mahogany is the most suitable wood, and the ornaments should be carved or inlaid, what little there is; japanned ornaments are not suitable, as these tables frequently meet with a little harsh usage.

The strength, solidity, and effect of brass mouldings are very suitable to such a design, when expence is no object. For instance, the pilasters might be a little sunk, or pannelled out, and brass beads mitred round in a margin, and solid flutes of the same metal let in. The astragal which separates the upper and lower parts might be of brass; and likewise the edge of the top, together with the patera in the upper pannel, as shewn on the left hand. The top is lined with leather or green cloth, and the whole rests and is moved on castors hid by the plinth.

Of the manufacturing Part.

THE top should be framed in inch and quarter wainscot, in the figure of a long hexagon, which best suits the shape of the oval. The pannels, which are tongued in, should be of at least three quarters hard mahogany, about nine inches square, and the stiles three and an half broad. The top being thus framed of very dry wood, it should be planed over, and stand for some time at a moderate distance from a fire, after which it may be glued together, and when hardened it ought to be planed over again, and remain in that state till the lower part is finished. If these methods are not pursued, the pannels will shrink, and their joints will draw down the leather or cloth, so that the

figure

figure of the framed top will appear, especially when it is lined with leather.

Next, it must be considered how to glue on the mahogany on the framing, so as to make the furbace moulding appear of solid wood. First, plough the four short sides of the hexagon, and then tongue in suitable mahogany lengthways, meeting in a straight joint in the center of the top; and, lastly, after the tonguing is dry, glue in straight joints pieces on the two long sides of the hexagon, and when dry, the top will be prepared for cutting to its elliptic shape.

The manner of framing the upper and lower parts of the carcase must be learned from the plan.

The upper part, framed in an entire oval, contains the desk-drawers; and, if thought necessary, two short ones may be obtained over the side niches.

The cupboard part is framed in two, each of which has a niche at the end, and one-third of the side niches; for the niches are all of them divided into three pannels, and the middle pannels of the side ones serve as doors, by which an open passage is gained through the table. There are four cupboards in the whole, divided in the manner specified by the dotted lines in

the

the plan, one or two of which may be fitted up in a nest of small drawers and letter-holes.

The plinth is framed entire of itself, and the base-moulding stands up a little to receive the whole and hide the joint.

In putting on the base-moulding there are two or three methods which I would offer as the best I know of. The frame being made so thick as to take the projection of the base, it must then be rabbeted out of the solid to receive it. This being done, proceed to glue the base in three or four thicknesses, confining them to their place by hand-screws, or other devices of that nature; but observe to let the base project further out than the deal plinth, that it may receive the mahogany veneer which is to be glued on lengthways to hide the deal.

After the whole is glued fast to its place, the veneer on the plinth and the base must be cleaned off level with each other. The convex parts of the base-moulding may be worked with hollows and rounds; and after these are finished, the niches should be worked down to them, by a tool made on purpose.

Another method of gluing the base-moulding is as follows: —Prepare the inch deal, and make cauls to fit the end and side niches of the plinth; after which take straight baited three-eighths

cights Spanish wood, and work the hollow part of the base separate from the torus; then, from quarter stuff of the same kind, cut off slips for the torus; heat the caul well, and both wet and heat the slips, which will then easily bend. When the hollow part is well tempered, and also the torus, begin at one end, and by a thin chip run glue in between them; and as you go on drive in nails about every inch, having between the nails and the moulding a thin slip of wainscot well heated. Observe to let the moulding pass beyond the caul at each end, that a pack-string may be tied to keep it to its place when it is taken out. The torus may then be worked before it is glued on the plinth.

A third method is, to make the plinth itself the caul, and first work the hollows, and soak them in water a whole night. Next morning take a hand-iron and heat it well, and over the curved side of which bend the hollow as near as may be to the sweep. Having already a stop screwed on the plinth, jump one end of the moulding to it, and glue as you go on; at the same time fixing small hand-screws to draw it to, or brads may be put through the square part to assist in this business, if necessary, for these will be covered by the torus. After the hollow is sufficiently dry, the torus being worked off and well soaked, and bent round the iron as above, it will glue to the hollow without the smallest difficulty, by first jumping it against the
stop

stop before mentioned; and after it is brought pretty near, take another stop and screw it against the end of the torus, which will draw it down without further trouble. These two methods are founded on experiment; for, at my request, it was performed by some cabinet-makers to my full satisfaction; therefore, should either of these methods fail in the hands of any, it must be owing to some defect in the management.

Of the Perspective Lines.

DRAW first a plan of the whole, and make GR the ground line, and HL the horizon. From the plan draw perpendicular lines from every part to GR, as shewn in the Plate; make *s* the center, and lay on the distance, which is here out of the plate. From each perpendicular line drawn to GR draw lines to *s*; then represent a parallelogram both at top and bottom, in which the ellipsis may be inscribed; and draw the diagonal corresponding with that shewn in the plan, which will cut the visual drawn from the said diagonal in the plan, finding a point to guide the ellipsis. For other particulars relative to the representation of an ellipsis, see page 294, and Plate XXI; for the representation of the niche, see page 295; and for the desk-drawer, see page 231, Prob. 4.

Of the Kidney Library Table. Plate LVIII.

THIS piece is termed a kidney-table, on account of its resemblance to that intestine part of animals so called. Its use, however, is the same as that already described.

The drawers which appear in the design are all real, and are strung and cross-banded, with the grain of the mahogany laid up and down. The pilasters are pannelled or cross-banded, and the feet below turned. The view of it below shews the ends pannelled, and the back may be so too, or it may be plain.

With respect to the manufacturing part, I need not say any thing after what has been said on the other, except to explain the reading desk which slides out, as shewn below. Observe, B is the profile of the frame which slides out, in the edge of which there is a groove shewn by the black stroke, and a tongue is put into the edge of the well part to suit it. F is the desk part which rises by a horse; and A is a part of that, which rises at the same time to stop the book; b is a tumbler-hinge let in flush with the top, and hid by the cloth or leather; c is a common butt-hinge let in the edge of F, and upon the frame B; so that when F falls to B, A does also. The length of the table is four feet, its width two, and its height thirty-two inches.

Of the Sofa Bed. Plate XXXI.

THE frames of these beds are sometimes painted in ornaments to suit the furniture. But when the furniture is of rich silk, they are done in white and gold, and the ornaments carved. The tablets may have each a festoon of flowers or foliage, and the cornice cut out in leaves and gilt has a good effect. The drapery under the cornice is of the French kind; it is fringed all round, and laps on to each other like unto waves. The valance serves as a ground, and is also fringed. The roses which tuck up the curtains are formed by silk cord, &c. on the wall, to suit the hangings; and observe, that the center rose contains a brass hook and socket, which will unhook, so that the curtains will come forward and entirely enclose the whole bed.

The sofa part is sometimes made without any back, in the manner of a couch. It must also be observed, that the best kinds of these beds have behind what the upholsterers call a fluting, which is done by a slight frame of wood fastened to the wall, on which is strained, in straight puckers, some of the same stuff of which the curtains are made.

The left plate shews the plan of the refter, and the manner of fixing the rods, which are made in two parts to pass each

other, so that the curtains may come close to each other in the center.

The tester rods screw fast in front, and hook past each other behind. The manner of fixing the tester up is by an iron bracket at each end; one arm of the bracket screws to the under-side of the tester, and the other against the wall, by driving in plugs for that purpose.

Of the Perspective Lines.

THE left plate shews these lines, and the right shews the scales of proportion. These beds seldom exceed twelve feet in height, including the feather at top. Their length is seven feet, and width about five.

The perspective lines are drawn by a contracted distance, being only one third of the whole. The front of the sofa is merely a geometrical elevation. For the apparent width of it take five feet from the small scale, which is termed one third of the real scale of feet and inches; place this measurement from 14 to *e*, and draw a line to *d*, cutting at 15; *a*, *b*, *d*, are for the tablets at each end; and at *f* is laid on the full measurement of the back tablet, from which lines are drawn to *s* the center, which

which cuts the back of the sofa at the line 15, 16, and determines its length. The back tablet being the highest, lay on the additional height from 10, and draw a line to *s*, cutting a perpendicular at 11; from which draw a parallel as shewn. The line drawn through *b* is to find the front of the dome, which comes forward rather short of half of the breadth of the sofa. The line 4 is the back of the dome, 5 is the center line, and 3 is its front; 7 shews the height of the under side of it, 8 of the top of the cornice, and 9 the top of the dome; the rest must be understood by observation.

Of the Alcove Bed. Plate XL.

THE term alcove, in buildings, means a part of a room separated off from the rest by columns and arches corresponding, in which is placed a bed: so that it is not the particular form of the bed which gives rise to this name, but the place in which it stands. The learned inform us, that the word alcove is from the Arabic *elcauf*, which means a cabinet or sleeping-place. This design is represented standing on a plinth, covered with carpet, and having a border round it supposed to be on the floor of the room. The steps are introduced to shew that beds of this sort are raised high, and require something to step on before they can be got into. The steps are generally covered with

with carpet, and framed in mahogany. Both this, the sofa, and French state bed, require steps. The dome of this bed is fixed in the same manner as the other; but the roses to which the curtains are tucked up are different. This is made of tin, and covered with the stuff of the bed, and unbuckles to take in the curtains behind the rose. Upon the fluting, as before mentioned, is fixed a drapery in this, as shewn in the design; and sometimes in the arch of the alcove a drapery is introduced.

Of the Summer-Bed in two Compartments. Plate XLI.

THESE beds are intended for a nobleman or gentleman and his lady to sleep in separately in hot weather. Some beds for this purpose have been made entirely in one, except the bed-clothing being confined in two drawers, running on rollers, capable of being drawn out on each side by servants, in order to make them. But the preference of this design for the purpose, must be obvious to every one in two or three particulars.

First, the passage up the middle, which is about twenty-two inches in width, gives room for the circulation of air, and likewise affords an easy access to the servants when they make the beds.

Secondly, the passage gives opportunity for curtains to enclose each compartment, if necessary, on account of any sudden change of weather.

Thirdly, it makes the whole considerably more ornamental, uniform, and light..

The first idea of this bed was communicated to me by Mr. Thompson, groom of the household furniture to the Duke of York, which, I presume, is now improved, as it appears in this design.

The manufacturing part may easily be understood from the design by any workman; I shall, however, point out a few particulars. The arch which springs from the Ionic columns should be glued up in thickness round a caul, and an architrave put on each side afterwards. The arch should be tenoned into the columns, with iron plates screwed on, so that it may be taken off when the bed is required to come down. In this arch a drapery is fixed, with a tassel in the center, and a vase above. The head-board is framed all in one length, and the two inner sides of the bed tenoned into the head-rail, and screwed. The tester is made in one, in which there are two domes, one over each compartment. It may, however, be made without domes, but not with so good effect. In the middle of the tester, perpendicular

cular to the sides of the passage, are fixed two rods, for the curtains above mentioned. These rods are hid by valances, and between the valances is formed a pannel, by sewing on variegated margins to suit the rest of the upholstery work. The ornamented margins, and the oval with crests in the center of the counterpanes, may all be printed to any pattern, at a manufactory which has been lately established for such purposes.

The scale shews the sizes which applies to every part of the end of the bed, it being merely a geometrical elevation.

Of the French State-Bed. Plate XLV.

BEDS of this kind have been introduced of late with great success in England.

The style of finishing them, with the management of the domes, is already described in general terms, in page 113, &c. I shall, therefore, omit it here, and proceed to give some hints relative to the manufacturing part. The dome is supported with iron rods of about an inch diameter, curved regularly down to each pillar, where they are fixed with a strong screw and nut. These iron rods are covered and entirely hid by a valance, which comes in a regular sweep, and meets in a point
at

at the vases on the pillars, as the design shews. Behind this valance, which continues all round, the drapery is drawn up by pulleys, and tied up by a filken cord and tassels at the head of the pillars. The head-boards of these beds are framed and stuffed, and covered to suit the hangings, and the frame is white and gold, if the pillars and cornice are. The bed-frame is sometimes ornamented, and has drapery valances below.

Observe, that grooves are made in the pillars to receive the head-boards, and screwed at the top, by which means the whole is kept firm, and is easily taken to pieces. Square bolsters are now often introduced, with margins of various colours stitched all round. The counterpane has also these margins; they are also fringed at bottom, and have sometimes a drapery tied up in cords and tassels on the side.

Of the Perspective Lines.

THIS design is in an oblique situation, so termed because none of its ends or sides are paralld to the picture. I have here taken the nearest angle of the bed for the center of the picture, from which raise a perpendicular as from seven on the scale line. Consider next the height of the horizon, which should be about five feet six, taken from the scale you draw the

bed by. On the perpendicular line now mentioned lay on the distance of the picture from the horizontal line. Then determine the position of one side of the bed, by drawing a line from the angle E to V; from V draw a line to the distance here out of the plate, on the aforefaid perpendicular; from the distance draw a line T U at right angles with this, which produced cuts the horizon, and finds the vanishing point for the ends of the bed; consequently V is the vanishing point for the sides of the bed. From 7 to A is seven feet, the length of the side; and from 7 to N is the width of the bed. From N A draw lines to D D, the dividing centers, or measuring points, found as in Problem VI. Method 2. page 237, which will cut the visuals for the apparent length and width of the bed. A perpendicular from 5 is the center of the end of the bed; S is the original height of the dome, from which a line is directed to the right hand vanishing point, cutting at *d*; a line from *d* finds the center of the dome, and V the top of the pine-apple; *c a* give the height of the cornice; the diagonals 1, 3, 2, 4, find the center of the dome, by raising a perpendicular from their intersection. Every other thing will follow of course to him who has previously studied the rules given; without which, it would be impossible to make every particular understood here.

Of the Drawing-Room Chairs. Plates XXXII, XXXIV.

THESE chairs are finished in white and gold, or the ornaments may be japanned; but the French finish them in mahogany, with gilt mouldings. The figures in the tablets above the front rails are on French printed silk or satin, sewed on to the stuffing, with borders round them. The seat and back are of the same kind, as is the ornamented tablet at the top of the left-hand chair. The top rail is pannelled out, and a small gold bead mitred round, and the printed silk is pasted on. Chairs of this kind have an effect which far exceeds any conception we can have of them from an uncoloured engraving, or even of a coloured one.

The perspective lines in the left chair may serve as hints; but I need not explain them, since I have fully done this in Plate XXIV. and XXVI.

The parlour chairs in Plate XXXIII. and XXXVI. need no explanation, as every one must easily see how they are to be finished.

Of the Sofa. Plate XXXV.

THESE are done in white and gold, or japanned. The loose cushions at the back are generally made to fill the whole length, which would have taken four; but I could not make the design so striking with four, because they would not have been distinguished from the back of the sofa by a common observer. These cushions serve at times for bolsters, being placed against the arms to loll against. The seat is stuffed up in front about three inches high above the rail, denoted by the figure of the sprig running longways; all above that is a squab, which may be taken off occasionally. If the top rail be thought to have too much work, it can be finished in a straight rail, as the design shews.

Of the Lady's Writing Table. Plate XXXVII.

THE convenience of this table is, that a lady, when writing at it, may both receive the benefit of the fire, and have her face screened from its scorching heat.

The style of finishing them is neat, and rather elegant. They are frequently made of satin-wood, cross-banded, japanned, and the top lined with green leather.

The manufacturing part is a little perplexing to a stranger, and therefore I have been particular in shewing as much as I well could on the plate.

Observe, that in the side-boxes the ink-drawer is on the right, and the pen-drawer on the left. These both fly out of themselves, by the force of a common spring, when the knob on which the candle-branch is fixed is pressed. Figure A is the spring which is let in under the candle-branch; C is a lever which is pressed to B, the end of the drawers, by a spring rising from D; N is a part of the candle-branch, and *e* is the knob just mentioned, which is capable of being pressed down; therefore, if P be screwed into E by pressing *e*, C rises and relieves B, which immediately starts out, by a common spring fixed on the inside of the boxes.

Observe a patera in the center of the back amidst the ornament. This patera communicates to a spring of precisely the same kind as A; which spring keeps down the screen when the weights are up: and by touching the said patera, which has a knob in its center like *e*, the spring is relieved, and the weights of course send up the screen, being somewhat assisted by a spring at the bottom, which may be seen in the design. Figure T shews the lead weight, how the pulleys are fixed, and the manner of framing the screen before it is covered with stuff.

The

The workman will observe, that a thin piece of mahogany slide, out in a groove, to afford access to the weights, and afterwards enclose them.

There is a drawer under the top, which extends the whole of the space between the legs.

The scale shews the length of the table, *b* its height, *a* the depth of the drawer, *b c* the depth of the side-boxes, and *e d* the height of the swell of the screen part ; the width of the table is twenty inches.

Of the Tripod Fire-Screens. Plate XXXVIII.

SCREENS of this kind are termed tripod*, because they have three feet or legs.

The middle screen may be finished in white and gold, or japanned; and the other two of mahogany, or japanned. The rods of these screens are all supposed to have a hole through them, and a pulley let in near the top on which the line passes,

* Tripod, of *τρεῖς*, *treis*, three, and *ποδόν*, *podon*, a foot. Anciently the word tripod used to be applied to a kind of sacred three-footed stool, on which the heathen priests were seated to receive and deliver their oracles: from which we may learn how time alters words.

and a weight being enclosed in the taffel, the screen is balanced to any height. The rods are often made square, which indeed best suits those which have pulleys, while those that are made round have only rings and springs.

Such screens as have very fine prints, or worked satin commonly have a glass before them. In which case a frame is made, with a rabbet to receive the glass, and another to receive the straining frame, to prevent it from breaking the glass; and to enclose the straining frame a bead is mitred round.

Of the Knife-Cases and Lady's Travelling-Box. Plate XXXIX.

LITTLE need be said respecting these. It is only wanted to be observed, that the corner pilasters of the left-hand case has small flutes of white holly or other coloured wood let in, and the middle pilasters have very narrow cross-bands all round, with the pannels japanned in small flowers. The top is sometimes japanned, and sometimes has only an inlaid patera. The half columns of the right-hand case are sometimes fluted out, and sometimes the flutes are let in. The feet may be turned and twisted, which will have a good effect.

As these cases are not made in regular cabinet shops, it may be of service to mention where they are executed in the best taste, by one who makes it his main business; *i. e.* John Lane, No. 44, St. Martin's-le-grand, London.

The Lady's travelling-box in the same plate, is intended to accommodate her in her travels with conveniences for writing, dressing, and working. The front is divided into the appearance of six small drawers; the upper three sham, and the under real. The writing-drawer takes up two of these fronts in length, and contains an ink-drawer, and a top hinged to the front, lined with green cloth. The top being hinged at front, by pushing in the drawer, it will rise to any pitch. The other drawer on the left, which only takes up one front, holds a kind of windlass or roller, for the purpose of fixing and winding up lace as it is worked. The middle vacuity, which holds the scissors and other articles of that nature, takes out, which gives access to a convenience below it for holding small things. The boxes on each side hold powder, pomatum, scent-bottles, rings, &c. The dressing-glass, which is here represented out of the box, fits into the vacuity above the scissor-case.

Of the Corner Bafon-Stands. Plate XLII.

THE right-hand bafon-stand contains a cupboard and a real drawer below it; by the top folding down the bafon is inclosed and hid when it is not in ufe. The left-hand top is fixed to the fide of the bafon-stand by a rule-joint, the fame as the flap of a Pembroke table; but inftead of iron the hinges are made of brafs. The right-hand top is hinged to the other by common butt-hinges, by which means it will fold againft the other, and both may be turned down together. When the tops are in their place, there then appears a rule-joint on both fides. The front edges of the tops are hollowed and beaded, which hang a little over, fo that the fingers may get hold to raife them up. Short tenons are put to the under edge of the right-hand top, to keep it in its place on the end of the lower part.

The bafon-stand on the left has a rim round the top, and a tambour door to inclofe the whole of the upper part, in which is a fmall ciftern. The lower part has a fhelf in the middle, on which ftands a veffel to receive the dirty water conveyed by a pipe from the bafon. Thefe fort are made large, and the bafon being brought clofe to the front, gives plenty of room. The advantage of this kind of bafon-stand is, that they may ftand in a

genteel room without giving offence to the eye, their appearance being somewhat like a cabinet.

Of the Designs in Plate XLIII.

THE drawer in the wash-hand stand is lined with lead, into which the bason is emptied. The upper part, which contains the cistern, takes off occasionally. Below the drawer is a cupboard. Observe, that in the design the drawer back is supposed to be behind the bason; but before the drawer is wholly taken away, the bason must be taken out.

Of the Pot-Cupboard.

THESE are used in genteel bed-rooms, and are sometimes finished in satin-wood, and in a style a little elevated above their use. The two drawers below the cupboard are real. The partitions may be cross-banded, and a string round the corners of the drawer. These feet are turned, but sometimes they are made square. Sometimes there are folding doors to the cupboard part, and sometimes a curtain of green silk, fixed on a brass wire at top and bottom; but in this design a tambour door is used, as preferable. The upper cupboard contains shelves, and is intended to keep medicines to be taken in the night, or to hold other little articles which servants are not permitted to overlook.

Of the Lady's Secretary.

THESE are sometimes finished in black rose-wood and tulip cross-banding, together with brass mouldings, which produce a fine effect. The upper shelf is intended to be marble, supported with brass pillars, and a brass ornamented rim round the top. The lower part may be fitted up in drawers on one side, and the other with a shelf to hold a lady's hat, or the like.

Of the Screen-Table.

THIS table is intended for a lady to write or work at near the fire; the screen part behind securing her face from its injuries. There is a drawer below the slider, and the slider is lined with green cloth.

The back feet are grooved out for the screen to slide in; in each of which grooves is fixed a spring to balance the screen by. The top is first cross-banded all round; then a border is put on, so broad as to fall exactly where the joint of the screen will be in the top. Beyond that again is put a narrower cross-banding. When the screen is down the top appears uniform, without any joint, at least not so as to be offensive to the eye. The framing

frame of the screen is made of thin wainscot, and framed in four pannels. When the said frame is covered in the manner of any other screen, flips are got out and grooved and mitered round, and a part of the top which rises up with the screen is glued on to the flip, and as of course the top will project over behind, so it affords hold for the hand to raise the screen by.

Of the two Tables, Plate XLIV.

THE left-hand table is to write and read at. The top is lined with leather or green cloth, and cross-banded. To stop the book there are two brass plates let in, with key-holes; and in the moulding, which is to stop the book, are two pins, with heads and shoulders, by which the moulding is effectually secured.

The right-hand table is meant to write at only. The top part takes off from the under part, which, having a bead let in at the back and ends of the top, prevents the top part from moving out of its place. This table being made for the convenience of moving from one room to another, there is a handle fixed on to the upper shelf, as the drawing shews. In the drawer is a slider to write on, and on the right-hand of it ink, sand, and pens. The sizes are shewn by the scales.

Of the Lady's Dressing Table. Plate XLVI.

THE style of finishing these tables is neat. They are often made of satin-wood, and banded; but sometimes they are made of mahogany. The size of this table, which is here three feet, should be increased in its length near six inches when these folding side-glasses are introduced. The reason of this is, that a lady may have more room to sit between them to dress. It should, in this case, be made about two inches wider. But, observe, the size here given is that which is used when only the rising back-glass is introduced; and this has been the common way of finishing them. These side-glasses are an addition of my own, which I take to be an improvement; judging that, when they are finished in this manner, they will answer the end of a Rudd's table, at a less expence.

The glass behind rises up like that of a shaving-stand. Those on the side, fold down past each other, being hinged to a sliding stretcher, which is capable of being pushed backward or forward. If the right-hand glass be pushed to the back it will then fold down, and the other keeping its place will do the same. A and B, in the plan, shew these glasses in their place; *e* is the back-glass, and *t* is the top, which is hinged to a piece of

of

of wood, which runs in a groove at each end, so that when the top is drawn fully up, it will fall down on the frame. The other folding top on each side have each of them a small tenon near the front, as may be seen at the edge of the left-hand one. These tenons being let into the middle part, are the means of securing each side-top, when they are folded down, and the middle part is put down upon them, so that the lock in the middle secures the three tops. The drawer on the right is the depth of two fronts, as is easily seen; the use of which is to put caps in. The left-hand fronts are in two real drawers, for the purpose of laying small things in. The cupboard in the kneehole has its front reeded in the hollow part to imitate tambour, and the circular door in the center is veneered and quartered. This cupboard will take a lady's hat as they wear them now. The other dressing conveniences are obvious in the plan.

Of the Perspective Lines.

THESE I only consider as hints or memorandums to such as have already gone through the regular treatise on the subject. an is the width of the table; and a line from a to d , the distance, cuts the visual ns in b , which gives the apparent width at that distance. The front of the table is supposed to be in the picture, and therefore every measurement is purely geometrical; that is, they are taken from the scale. From r to o is the width of

of

of the top, except the flip behind. Therefore by drawing a perpendicular at p , and directing a line from o to s , the center, it will cut at p , and give the height of the top, supposing it to be raised quite up, ready for turning down.

Of the Cylinder Desk and Book-case. Plate XLVII.

THE use of this piece is plain, both from the title and design. The style of finishing them is somewhat elegant, being made of satin-wood, cross-banded, and varnished. This design shews green silk fluting behind the glass, and drapery put on at top before the fluting is tacked to, which has a good look when properly managed. The square figure of the door is much in fashion now. The ornament in the diamond part is meant to be carved and gilt, laid on to some sort of silk ground. The rim round the top is intended to be brass; it may, however, be done in wood.

Of the manufacturing Part.

THE manufacturing part of this piece is a little intricate to a stranger, for which reason it will require as particular a description as I can give to make it tolerably well understood.

First,

First, observe the slider is communicated with the cylinder by an iron trammel, as I, so that when the former comes forward, the latter rises up and shews the nest of the small drawers and letter holes, as appears in the design. When, therefore, the slider is pushed home even with the front, the cylinder is brought close to it at the same time. In this state the lock of the long drawer under the slider secures both the drawer itself and also the slider at the same time, in the following manner:—D is the long drawer under the slider, P the partition above it, and S is the slider; C is a spring-bolt let into the partition. When, therefore, the drawer lock-bolt is out, as it rises it drives C, the spring-bolt, into the slider; and when the drawer is unlocked, then C falls down to its place in the partition, and the slider can be pulled out. The trammel I, is a piece of iron near a quarter thick, and inch and quarter broad, with grooves cut through, as shewn at I. S, in the profile, is the slider; and *g*, *12*, *b*, the cylinder. The trammel T is fixed to the cylinder at *b* by a screw, not drove tight up, but so as the trammel will pass round easy. Again, at the slider S a screw is put through the groove in the trammel, which works on the neck of the screw, and its head keeps the trammel in its place; so that it must be observed, that the grooves or slits in the iron trammel are not much above a quarter of an inch in width. When the slider is pushed in about half way, the trammel will be at *u*, and its end will be below the slider, as the plate shews; but when the slider is home

home to its place, the trammel will be at T and g. The center piece with four holes is a square plate of iron, having a center-pin which works in the upper flit of the trammel. It is let into the end of the cylinder, and fixed with four screws. To find the place of this center, lay the trammel upon the end, as T b, in the position that it will be in when the slider is out, and, with a pencil, mark the inside of the flits in the trammel. Again, place the trammel on the end as it will be when the slider is in, as at T g, and do as before; and where these pencil marks intersect each other will be the place of the center-plate. The figures 1, 2, 3, 4, shew the place of the small drawers. The triangular dotted lines with three holes, is a piece of thin wood screwed on to the end, to which is fixed the nest of small drawers, forming a vacuity for the trammel to work in. F is a three-eighth piece veneered and cross-banded, and cut behind to give room for the trammel. This piece both keeps the slider to its place, and hides the trammel. The next thing to be observed is, that the lower frame, containing two heights of drawers, is put together separate from the upper part, which takes the cylinder. The ends of the cylinder part are tenoned with the slip tenons into the lower frame and glued. The shaded part at A shews the rail cut out to let the trammel work. The back is framed in two pannels, and the back legs are rabbetted out to let the back framing come down to the lower drawer. The slider is framed of mahogany, with a broad rail at each end about nine inches, and

one at the front about three and an half. In the inside of the framing a rabbet is cut to receive a thin bottom. The bottom being fixed in, a flip is put at each end to receive the horse which supports the desk part. The ink and pen drawers at each end of the slider have a small moulding mitred round them to keep them fast, without their being glued on. Observe, there is a sham drawer-front fastened on to the slider, which of course goes in with it, and which contains the depth of these ink and pen drawers, so that they are not required to be taken out when the slider goes in. The cylinder is jointed to its sweep in narrow flips of straight-baited hard mahogany, and afterwards veneered. If the veneer be of a pliable kind it may be laid with a hammer, by first shrinking and tempering the veneer well, which must not be by water, but thin glue. If the veneer be very cross and unpliant, as many curls of mahogany are, it is in vain to attempt the hammer. A caul in this case is the surest and best method, though it be attended with considerable more trouble than the hammer. To prepare for laying it with a caul, proceed as follows.—Take five or six pieces of three-inch deal, and sweep them to fit the inside of the cylinder. Fix these upon a board answerable to the length of the cylinder. Then have as many cauls for the outside of the cylinder, which may be made out of the same pieces as those for the inside. Take then quarter mahogany for a caul to cover the whole veneer, and heat it well. Put the caul screws across the bench, and flip in the
board.

board with the round cauls screwed to it; and proceed, in every other particular, as the nature of the thing will necessarily dictate.

Of the Perspective Lines.

GR is the ground line, and HL the horizon; *s* the center, and *d* the distance of the picture. AB, on the ground line, is the breadth of the ends; from which a line is drawn to *d*, cutting the visual Bs, for the perspective breadth of the end. O is the height of the lower part, and the upper part being level with the horizon, appears in one line, and therefore shews no breadth at the top.

Of the Cabinet. Plate XLVIII.

THE use of this piece is to accommodate a lady with conveniences for writing, reading, and holding her trinkets, and other articles of that kind.

The style of finishing them is elegant, being often richly japanned, and veneered with the finest satin-wood.

The manufacturing part is not very difficult, but will admit of the following remarks.—The middle drawer over the

knee-hole has a slider to write on, and those on each side are plain. The doors under them are hung with pin-hinges, and in the inside there is one shelf in each. The cupboard within the knee-hole is fitted up in small drawers, and sometimes only a shelf. The pilasters or half columns are put on after the carcase is made. The corner ones are planed square first, and then rabbetted out to receive the angle of the carcase, and afterwards deal is glued in a slight manner into the rabbet, that it may be easily taken out after the column is turned.

The center door of the upper part is square at the top, opening under the astragal which finishes the cove part. The pilasters are on the door frame, and the drapery is formed and sewed to the silk, and both are tacked into a rabbet together. Behind the silk door are sliding shelves for small books. The wings are fitted up as shewn in the design on the right, or with more small drawers, having only two or three letter holes at the top.

Of the Perspective Lines.

GR is the ground line, HL the horizon, and sd only half the full distance of the picture; wherefore ga is only half the original measurement of the ends of the cabinet. A perpendicular from e determines the front of the upper part, and all those

those visuals drawn to s are obvious in themselves. The perpendicular lines cc , at the cove, shew the centers for drawing it. The right-hand door opens more than square, consequently it is oblique to the picture; and being oblique, the top and bottom of it tend to some vanishing point out of the center of the picture, as is denoted by the lines nn, ss . These two, if produced, would meet in a point on the horizon, and that point is termed the vanishing point of all lines parallel to the top and bottom of the door. The door turning on its hinges describes a semicircle, as is shewn; and, consequently, every opening of the door must come within the circumference of that semicircle.

Of the Lady's Cabinet Dressing-Table. Plate XLIX.

THIS table contains every requisite for a lady to dress at.

The style of finishing them is neat and somewhat elegant.

With respect to the manufacturing part, and what it contains, these may be learned from the design itself, which here shews the parts entirely laid open. I shall therefore only mention two or three particulars. When the washing-drawer is in, a slider which is above it may be drawn out to write on occasionally. The ink and sand are in the right-hand drawer under

the center dressing-glass. Behind the drapery, which is tacked to a rabbet, and fringed or gimped, to cover the nails, is a shelf, on which may stand any vessel to receive the dirty water. Above the drapery are tambour cupboards, one at each end, and one in the center under the drawer. Above the tambour at each end are real drawers, which are fitted up to hold every article necessary in dressing. The drawers in the cabinet part are intended to hold all the ornaments of dress, as rings, drops, &c. Behind the center glass is drapery; it may be real to suit that below, or it may only be painted in imitation of it. The glass swings to any position, on center pins fixed on the shelf above the candle-branches. The side-glasses fold in behind the doors, and the doors themselves, when shut, appear solid, with ovals in the pannels, and ornamented to suit the other parts. Observe, the whole plan of the top is not in the plate, it being required to be two feet over.

The perspective lines shewn at the circular end, are as follows.—When the plan is made, divide the curve into parts, as shewn; and from these divisions on the ground line, draw lines to the center *s*. Then turn up the ordinates to the ground line; and from the points where they cut on that line, draw lines to the distance, as shewn, which will cut the visuals at 6, 7, 8, 9, and so on, finding points to direct the curve by.

Of the Lady's Cabinet and Writing-Table. Plates L.

THIS table is intended for writing on, and to hold a few small books in the back of the upper part. Within the door at each end, under the domes, are formed small cabinets of drawers, &c. The front of the upper part, which incloses the nest of drawers and letter holes, slides in under the top, and when drawn sufficiently out falls down in the curve *fg*, and locks into the folding top.

The method of hinging this front is thus:—Suppose *B D* to shew it up, as it is in the design, ready for pushing home. Then observe, *D d* is a flip which runs in a groove cut at each end. The front *B* is rabbetted out, and also the flip *D*. These are hinged together, and are both of one thickness, so that when *B* is drawn out, the flip having a tenon at *d*, stops it from coming entirely out. The other figure shews the front when it is let down, which cannot fail of making it understood. The dotted curve line *o P* shews that the under side of the top must be hollowed out so that the angle of the falling front may clear itself as it turns.

Observe,

Observe, the writing part folds over like a card-table, and when it is open, is supported by the drawer in the frame. Every other part must be plain to the workman.

N. B. Upon the same principles the top of the dressing-table, Plate XLVI. is managed.

Of the Drapery. Plate LI.

LITTLE can be said of this, as every part explains itself, as represented in the drawing. It is, however, necessary to observe, that the French strapping and tassels in the right-hand design is no part of the cornice, as some cabinet-makers have already mistaken it to be. It is the upholsterer's work, and is sewed on within the valance or ground of the drapery.

These curtains are drawn on French rods. When the cords are drawn the curtains meet in the center at the same time, but are no way raised from the floor. When the same cord is drawn the reverse way, each curtain flies open, and comes to their place on each side, as they are now represented. The cord passes on a side pulley fixed on the right-hand.

To effect this, the rod is made in a particular manner, having two pulleys at one end, and a single one at the other, which cannot well be described in words without a drawing of it.

Of the Gentleman's Secretary. Plate LII.

THIS piece is intended for a gentleman to write at, to keep his own accounts, and serve as a library. The style of finishing it is neat, and sometimes approaching to elegance, being at times made of satin-wood, with japanned ornaments.

Of the manufacturing Part.

THE great thing to be observed in this, is the management of the fall A, or writing part, which is lined with green cloth. This fall is hung by an iron balance-hinge B, so that when the fall is raised up by the hand a little above an angle of forty-five degrees, or in the position it is shewn at A, it falls to of itself by the balancing power of B.

When A is in a horizontal position, B is at F, the inside of the pilaster, on which is glued a piece of cloth to prevent the

iron from rattling. B stopping at F it is evident how firmly the fall is supported by that means; for the hinge is made very strong, about three quarters thick at the dove-tail end, and tapered off to about a quarter thick at the joint, and where it is screwed to the fall. The hinge is made in two parts, as D and *b*. D has a center pin, and is screwed on to the inside of the pilaster, as at *d*; *b* is all in one piece, and is screwed on to the fall, having a center hole to receive the abovementioned pin in the other part of the hinge.

It is necessary to observe, that there is a vacuity behind both the upper and lower pilasters in which the iron balance operates, so that nothing is seen but the mere joint of the hinge.

Again, it is requisite to observe, that a hollow must be worked on the upper side of the under carcass, to give place to the circular motion of the under angle of the fall, as it turns upon its hinge from a perpendicular to a horizontal form. This hollow may be observed in the plate. The space 1 contains the fall when it is up; 2 is an open space, which affords room for the rings on the small drawers; and 3 is the pilaster. The ornamented freeze under the cornice is, in reality, a drawer, which springs out, when the bolt of the fall-lock is relieved. This is done by a spring-bolt let into the partition under the
 drawer,

drawer, which is forced up by the bolt of the fall-lock into the under edge of the drawer; and when the fall is unlocked this spring-bolt returns to its place in the partition, and a common spring screwed on to the drawer-back sends it forward, so that it may be drawn out independent of a ring or handle.

When the fall is up, there appear two pannels in the form of those below. As for any other particular, it must be understood by a workman.

Observe, the dimensions of every part may be accurately taken from the profile by the scale.

Of the Cylinder Wash-hand Table. Plate LIII.

THESE are always made of mahogany, and having a cylinder to rise up to hide the washing apparatus, they look neat in any genteel dressing-room.

They also contain a bidet on the right near the front, and D, a water-drawer on the left near the back, so that when the two are pushed home they pass by each other. The drawer on the front, which appears partly out, runs above the bidet and the water-drawer. The two heights of sham drawers above contain the cylinder, and the two heights of sham drawers be-

low contain the bidet and water-drawer. The basin has a plug-hole at the bottom, by which the water is conveyed off into the drawer D, which is lined with lead. The top of the cistern is hinged, and can be turned up at any time to fill it with fresh water. The glass rises up behind, in the same manner as that of a shaving-stand. And when the glass is down, the top can be turned down also; and the cylinder being raised to meet it, the whole is enclosed. The motion of the cylinder is guided by two quadrant pieces, one at each end of it, which are hinged to the top in which the basin hangs. This is shewn by A in the profile; which, when the cylinder is let fall to its place, will be at B. When the cylinder is raised up to A, it catches at C, which is a spring of the same kind as those put on to secretory drawers. The bidet-drawer is sometimes made to take quite out, having four legs to rest on. The end of the piece of work is cut out so as the feet can go in without being folded up. This, in the design, is stopped from coming quite out, and the framed legs, which appear, fold under the drawer and slip in along with it.

Of the Pembroke Table and French Work Table. Plate LIV.

THE use of this piece is for a gentleman or lady to breakfast on.

The style of finishing these tables is very neat, sometimes bordering upon elegance, being at times made of satin-wood, and having richly japanned borders round their tops, with ornamented drawer-fronts.

The manufacturing part of this table differs but very little from those in common use.

The fly brackets which support the flaps are made and fixed in the same manner as any other, only I apprehend it best to make a dove-tail groove in the front for the drawer sides, at a distance from each end of the drawer-front equal to the thickness of the bracket and the inner lining; so that the front laps over and covers the whole, as appears in the design. In this case the lock-bolt shoots up into the top of the table. The top and frame may be connected to the pillar and claws, either by a square block glued up, or by a couple of pieces, about four inches broad, half-lapped into each other at right-angles, and double tenoned into the pillar, and screwed to the bottom of the frame, as the profile of the pillar and claw is intended to suggest.

The workman is desired to observe, that the top of the table, as shewn in the design, is not meant to represent a regular ellipsis, as they are generally made a little fuller out at each corner

corner of the bed. The reason of this is, that the flaps, when turned down, may better hide the joint rail.

Of the French Work Table, Plate LIV.

THE title of this table sufficiently indicates its use. The style of finishing them is neat, being commonly made of satin-wood, with a brass moulding round the edge of the rim.

The front part of the rim is hinged to the top, in the same way as the front of a secretary or desk-drawer; so that when it is turned up, it fastens by two thumb-springs as they do. The brass moulding is mitred upon the edge of the rim when the front is up, and after it is hinged; which being cut through with a thin saw, the moulding, on the return of the front, will be fair with that on the end.

The shelf below is shaped something like a boat. The bottom of it is made of inch stuff, and double tenonned into the standards, as the profile plainly shews. The top of each standard has also double tenons, to which cross-bars are morticed and screwed to the under-side of the top.

The scale shews the proportions of the standard, and the height of the table; its breadth is fourteen or fifteen inches.

The boat part, which serves as a convenience for sewing implements, is six inches over the middle, and three at each end.

I have, in these two designs, introduced strict shadowing, that the learner may better judge of its effects in such cases.— But I must observe the shadows here are rather too faint, because I was afraid to make the plate look heavy. The sun's rays are here considered parallel to the picture, which is fully illustrated, by different cases, in the Treatise on Shadowing, see page 328. And, therefore, I shall only observe here to the learner, that, in making out the shadows of objects, a harsh outline ought carefully to be avoided. In fact, there ought to be no outline at all, except those first drawn by a pencil to determine the boundaries of the shadow; after which a large hair pencil should be used to fill up the shadow. We may likewise remark, that if Nature be observed duly, she teaches us that the shadows of objects are stronger nearest the foot or place where they rest, and grow fainter the further they recede from the foot of the object. The reason of this is: because if shadows are very long, as from a house, there is a strong reflection of light towards the boundaries, which mixes with the shadow, and consequently weakens it. It is somewhat similar to what astronomers term a penumbra, or imperfect shadow accompanying a total one.

Lastly,

Lastly, it may also be observed, that when an object is totally immerfed in the shadow of another, as the table claws are in the shadow of the top, there is a fort of additional shadow, occasioned partly by reflection, and partly by the contact of the two surfaces, but these are short and imperfect in their boundaries.

Of the Tripod Candle-Stand. Plate LV.

THESE are used in drawing-rooms, for the convenience of affording additional light to such parts of the room where it would neither be ornamental nor easy to introduce any other kind.

The style of finishing these for noblemen's drawing-rooms is exceeding rich. Sometimes they are finished in white and gold, and sometimes all gold, to suit the other furniture. In inferior drawing-rooms they are japanned answerable to the furniture.

Persons unacquainted with the manufacturing part of these stands may apprehend them to be slight and easily broken; but this objection vanishes, when it is considered that the scrolls are made of strong wire, and the ornaments cemented to them.

I could

I could not shew to advantage more than three lights, but, in reality, there are four; one at the center, and one at each angle. The top of the left stand is a round vase, which can be turned and have the square handles put on afterwards. The handles should be placed parallel to two of the feet. The top of the right one is a concave spherical triangle, having all its sides equal.

As to any other part, the workman's own notions will suggest every thing necessary in their manufacture.

Of the Harlequin Pembroke Table. Plate LVI.

THIS piece serves not only as a breakfast, but also as a writing table, very suitable for a lady. It is termed a Harlequin Table, for no other reason but because, in exhibitions of that sort, there is generally a great deal of machinery introduced in the scenery.

Tables like this have already been made, but not according to the improved plan of the machinery here proposed.

In this, however, I assume very little originality or merit to myself, except what is due to the manner of shewing and

describing the mechanism of it: the rest is due to a friend, from whom I received my first ideas of it.

The particular advantages arising from the machinery are as follows :

First, the nest of drawers, or till, shewn in the design, can be raised to any height, gradually, until at length the whole is out.

Second, when the whole is out, as represented in the design, it cannot be taken away, because of three stops which keep it in; two at one end, and one at the other, according to the grooves in No. 1.

Thirdly, but if necessity require that the till should be taken quite away from the rest of the table, in order to come at the machinery, then one of these stops at one end is so constructed that it can be flipped back, and, the till being raised up at the same end where the stop is flipped back, the two at the other end of course will relieve themselves, so that the till can be taken quite away.

Fourthly, when the till is replaced, the stop can be pushed into the groove again by the finger, which returns again into the groove by the force of a small spring.

Fifthly,

Fifthly, The till being let down again until it is perfectly even with the rest of the table-top, it can then be secured in its place by means of another stop at the bottom, so that if the whole table were turned upside down the till would still keep its place.

Sixthly, although the till be raised and lowered by turning the fly-bracket which supports the flap, yet the bracket is made to lose this effect or power by the turn of a key, and the bracket may then be drawn out to support the flap without raising the till, and the table can then be used, as in common, to breakfast upon.

These are all the advantages that are necessary, or that can be looked for, in tables of this sort, to render them complete, and to obtain the approbation of the ingenious.

But it will now be requisite to shew in what manner the machinery operates so as to effect these; and, likewise, to give some description of its parts, that the workman may be able to form a proper idea of the whole.

The first and great thing to be attended to is, to shew the manner of raising the till by turning the fly-bracket. To accomplish

comply with this, I have given a perspective view of the whole machinery at No. 1. Supposing the till to be taken out, and the fly-brackets and inner lining away from the framing; ab is an upright iron axis, made in two parts, and connected together by a round pin at the joint b ; of course, if the winch c be turned round, the axis a will turn round with it by the above pin, without moving the lower part of the axis b . Whence it is evident, that if the winch c be screwed to the under edge of the fly-bracket, which bracket is shewn in the design, it will turn round without affecting any part of the machinery. This is the cause why the flap of the top can be up whilst the till is down. But if the square socket a be pressed down past the joint b , the two parts of the axis will then be confined together, and therefore if the winch c be moved this way, it is evident that the machinery will instantly be put in motion in the following manner :

The winch c being screwed to the fly-bracket, and turned square out, it describes by its passage a quadrant of a circle; and the arm s of the crank-rod being fixed fast into the same axis ab , consequently it will describe the same curve as the bracket: and as the crank-rod R is jointed into its arm at s and at t , in moving the arm the rod R is pushed forward to j , and the horizontal cog-wheel H of course turns to the left-hand on the center C . It being then turned to the left, as expressed by the dotted

dotted line at *q*, it follows that the upright cog wheel *N* must be turned to the right-hand; and if this be turned to the right-hand, then must also the quadrant cog-wheel *Q* on the left turn to the right with it: and, because the axis *A* is fixed fast in the wheel *Q*, and the crooked levers *ee* into *A*, consequently the rollers *L L*, fixed by the rod *o* to these levers, will describe a quadrant of a circle, as denoted by the dotted line and the roller *g*; because the connecting cog-rod *5* makes *Q* move in the same curve as *N* does. Again, if *N*, the upper part of the upright cog-wheel, move to the right, then must *M*, the lower part of it, move to the left; and, being connected with the cog-rod *6*, and it again to the right-hand quadrant cog-wheel *Q*, it follows, as before, that the levers *ff*, and the roller *L*, will describe a quadrant of a circle to the left-hand, as at 8. The reader must easily see now, that when the winch *c* is turned by the fly-bracket, that every part of the machinery will be put in motion, and that the levers and rollers, in approaching gradually to 8 and 9, must necessarily raise up the till. But it must also be observed, that the motion of the levers *ff* and *ee* is greatly promoted by the power of the common steel-springs *SS*; for, when the till is down, these are always charged; that is, the sides of the springs are nearly close to each other, and these being connected with what may be termed the auxiliary, or assistant cog-rods, 4 and 7, and consequently pressing against their ends, the quadrant cog-wheels *QQ* are thereby made to revolve, and the levers and rollers are raised almost

as much by this means as by the other machinery. It must also be noticed, that as these springs and auxiliary rods greatly assist the other power in raising the till, so do they also check the sudden fall of it, by a constant resistance against the pressure of it, so that the passage of the till downwards is made by this mean smooth and easy.

Observe, p, p, p, p , are brass pulleys fixed to keep the cog-rods in their place, and ww are pieces of wood to keep the springs firm to their center.

The reason why there are but three rollers, and two of them at one end, is obvious; because the till must rest truer on three points than on four. It cannot totter on this account when it is fully raised, because there are two stops at that end where there is only one roller, which run in the grooves GG ; and if the stops chuck up to the end of the grooves when the till is up, it is impossible that it can totter, considering that the other end is upon two rollers. And here let it be noted, that if the workman find any inconvenience owing to the double roller o being at the same end with the axis $b b$, it can be removed by putting the double roller where the single one is, which makes no difference with any other part of the machinery. And observe, that when the rollers are nearly perpendicular to their axis AA , they enter upon an inclined plane, or on thin pieces of wood
planed

planed off like a wedge, of the width of the rollers, and whose thin end is glued to meet the rollers as they rise, so that the till can thereby be raised as high as we please. These wedges being glued on the under side of the till to suit exactly the place of the rollers, the projection of the wedges below the till makes it necessary that there should be a vacuity in the axis A A, for them to fall into when the till is down; because, in this situation, the till rests on the three rollers, which are nearly on a level with the axis A A. And as the wedges above mentioned must lie across the axis A A when the till is down, every workman must see the necessity of a vacuity, or otherwise the till would not settle to its place.

The next thing in order is to shew how one of the stops can be relieved, or slipped back, so that the till may be taken quite away. The construction of this stop is shewn by No. 4, which supposes that we see the under-side of the till. A is a hole cut through the till, which hole is drawn by a compass, having one foot at C the center. P is a round pin, which comes through to the inside of the bottom of the till. K is a tin key which hooks this pin. In applying this key to the pin, the writing slider, shewn in the design, must be pushed in, and the front-part which covers the letter holes turned up to its place; and there being a groove across the under side of the slider, exactly

where the pin comes, and the slider giving a little way for the thickness of the aforesaid key, the groove just mentioned admits the key over the head of the pin P; then, when the key is drawn back again, P moves toward A by the center C; and S, the stop which projects beyond the till, is by this mean drawn within. B is a plate screwed on to the till to keep the stop firm. Again, when the till is down to its place, it is necessary that it should be stopped there also, as has been already said. The apparatus for this is shewn at No. 3, which is a different view of the same lock as at No. 2. 1, 2, 3, 4, is supposed to be a part of the bottom, not of the till, but that whereon the machinery is placed at No. 1. *ts* is a kind of trammel with flits in it, moving on a center at *s*. A pin is fixed to the bolt of the lock, and there being a passage for the pin cut out of the lock-plate, as shewn in the design, this pin moves up and down, according as the key is turned. *a* is a kind of lever, with two arms, moving at the center *a*. *cc* are staples which are fastened to the under-side of the till, and as the bolt of the lock shoots downwards, the trammel *ts* throws the arms of the lever out of the staples which are fixed to the under-side of the till; by which means the till is relieved, and can then be raised by drawing out the fly-bracket. And here the workman must be careful to observe, that when the bolt *b*, No. 1, is shot, as it now appears, the till is always relieved, and the bracket at the same time has

power

power to raise the till ; because the fork D works in the groove *d* of the axis *a b* at No. 1, and thereby presses the socket *a* to *b*, and gives the winch *c* power over the machinery. And observe further, that when the bolt *b* at No. 2 is up, as it is shewn at No. 3, then it is evident that the arms of the stop-lever will pass through the beforementioned staples at the underside of the till and secure it, while, at the same time, the bracket will lose its power over the machinery ; because the socket *u*, at No. 1, is thereby raised above *b*, and of course as *b* turns on a pin, the winch *c* cannot affect the crank-rod *s R*, and therefore no part of the machinery is moved. Thus it is, I think, sufficiently clear that the till can be stopped and relieved when it is either up or down, and also that the bracket can be drawn out to support the flap, while, at the same time, the till is both down and stopped, so that the whole may be used as a common breakfast table.

It remains now to give some hints respecting the manufacturing part.

Of the Table Top.

THE size of the table when opened is four feet, and two feet seven inches long ; and the rails eight and a quarter deep.

The whole top is divided into four compartments, to answer the opening for the till. Round these compartments is a japaned border, to fill up the space which lies between the end of the table and the end of the till. This border must be continued all round alike, to make the pannels appear uniform and of equal size. The bed of the top should be framed in two pannels of three-quarters mahogany well seasoned, and the breadth of the stiles to suit the opening of the till. A pannel of half-inch stuff should be tongued into the other part of the bed where the till does not rise. Then, for the sake of the astragal which is to be worked on the edge of the top all round, a piece should be tongued in, the long way of the grain, into each end of the bed. And observe, that as the bed of the table will frequently have to be taken off in the course of the work, it is best to put small tenons into the under side of it, and mortices into the rails all round; by which means the bed will be kept to a certain place, and taken easy off at any time. A black string is put next the till, all round the inside of the border, to hide the joint. In putting this black string on at the opening of the till, the inside of the mahogany frame should be rabbetted out to take a slip of black veneer about three-eighths wide; and it being left to stand above the framing the thickness of the veneer, this black slip can be shot by a rabbet-plain to the thickness of a neat string, and the veneer must be jumped to it. The use of this is, that when the till rises it may not take any part of the string away

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with

with it, which it certainly would do if it were put on merely as a corner string.

Of the Till.

THE carcass of the till is made of half-inch mahogany; the partitions and letter-holes of thin quarter stuff, and black beads put on their edges, all of which must be kept back about half an inch from the edge of the carcass, to give place to the writing-slider; part of which turns up as a front to the inside of the till, and part of it remains in it: and, as a part of the writing-slider remains in the bottom of the till below the drawers, consequently there must be a joint in the slider to answer it; which joint is hinged at each end, before the cross-band is put on for the green cloth. The workman may make the hinges himself to suit that purpose. They may be made as common desk-fall hinges, only the knuckles of the hinge are made a little higher than common to receive a thin veneer; which, when screwed on, the veneer for the band of the cloth lies upon and covers the straps, so that a part of the knuckle is only seen: but observe, that the ends of the veneer, each meeting at the knuckle, must be cut in a sloping direction, so that they and the brass knuckle between them will be exactly in the form, and of the same nature, as the rule-joint of a fly-bracket for a Pembroke table;

table; and therefore it must be evident to every workman that the front will turn up square. The slider is stopped into the till by a couple of pins which run in grooves; and when it is pushed home, before it can turn up, a hollow must be worked in the bottom of the till, to give room for the angle of the rising part of the slider to turn in. When the slider is turned up, it is kept in its place by a spring-catch, which strikes into a plate put on at the under side of the top of the till. And observe, that when the front is up, it should be rather within the carcass of the till, both for the purpose of letting the till go easy down, and to admit of a flip of thin green cloth at each end, so that when the front is turned upon the top of the Pembroke table it may not scratch it.

Another method may, however, be proposed, and which will be attended with less trouble; only with this disadvantage, that it takes off a little of the height of the drawers.

The slider, being made in two parts, may be hinged in the manner of a card-table top, which, when it is folded over, can be pushed to its place. But observe, that the under top must be made so much broader than the upper one, as will admit of its being stopped in after the manner of the other; so that when it is drawn out, the upper top will rise and clear the drawer fronts. If the slider be made in this manner, the drawers can
then

then be brought within a little of the front edge, and what remains serves to give place to a couple of thumb-nail holes to draw out the slider by.

N. B. The prospect door is made to run in at the top like a drawer, upon the same principles as the front of the cabinet in Plate L.

Of the Frame of the Table.

THE legs are made a little stronger than usual, because the table is pretty heavy altogether.

Both the end rails are divided into four drawers each, in appearance; but, in reality, there are but two in the whole: for observe, that, for the sake of strength in the frame, the lower drawer of the left hand is made real, and that above it is a sham; but at the other end, which is not seen in the design, the upper drawer is real, and the under one a sham. A middle rail is tenoned, of inch stuff, into each end rail. Against this rail the upright part of the machinery is fixed, as shewn at No. 1; and as this rail stands within the edge of the top-framing about an inch, it contains the whole projection of every part of the machinery, so that the till passes without obstruction.

The inner lining for the fly-brackets to fall against, is not less than three quarters thick when planed ; and it must be the whole breadth of the end rails, i. e. eight and a quarter. The fly-bracket makes up the remaining thickness of the foot, and comes down low enough to answer the height of the upper cross-band of the lower drawer. The part remaining below the bracket is veneered the whole length with satin-wood, and cross-banded, to match the drawer fronts. The workman, in making the fly-bracket to which the winch *c* is screwed, must observe to make a shoulder pin on the turning part of it at the under edge : and this shoulder will require to be double the usual thickness, that the iron winch *c* may be let into the bracket without injuring the rule-joint, or interfering with the wire of its center.

The lock, at No. 2 or 3, is put on at the inside of the inner lining, so near to the axis *a b*, at No. 1, as that the fork *D* of the lock shall extend to the groove *d* in the socket of the axis *a b*, which then will determine the place of the key-hole, as shewn in the design.

Of the Pediments. Plate LVII.

WITH respect to these pediments little can be said, as the designs themselves shew in what manner they should be executed.

No. 1. Should have the facia, or ground board, glued up in three thickneses, having the middle piece with the grain right up and down. The foliage ornaments are cut out along with the astragal, and planted on; and the whole may easily be made to take off from the cornice, by having a tenon at each end and one in the center.

No. 2. The tablet part is intended to have a cross-band round it, and the drapery may be japanned. The astragal on the top of it is meant to return over the ogee. The square of the ogee may come forward, level with the tablet, to prevent too great a projection.

No. 3. In the center there are two pilasters to project a little from the ground, which are fluted. The pannels at each end are intended to be ~~fanned~~ the reverse way, or with the rounds out.

No. 4.

No. 4. The scrolls are continued in one piece from the foliage, and planted on.

No. 5. The center is intended to be veneered and cross-banded, with an oval let in, and japanned. The pedestal above is intended to be thrown back in a hollow carved in leaves. The foliage on the scrolls is meant to lap on the astragal, and to finish off at the patera. The ground of the fascia is fanned out.

Of the Cornices. Plate LIX.

IN these cornices the spring is shewn, and the proper gaging is pointed out. The width and thickness also of the mahogany is shewn. The astragal, in No. 3 and 5, can be worked separate, and glued on afterwards. The pateras, in No. 6, are turned and planted on.

Of the Method of gaging and working Cornices.

THE explanation of this may be thought, by some, an unnecessary business; but from the bungling manner in which I have seen many workmen proceed to stick cornices, I am certain

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tain that a few hints will be of service, especially to the inexperienced. For this purpose I have, in No. 1, lettered each gage-point, and I shall proceed as supposing that it is necessary that the whole should be taught.

When the pattern of any cornice is given to be worked, take the drawing and strike a line *an* to touch as near as may be each member. From this front line strike one at each end square from it, so as to take in the whole extent of the cornice. Then draw another line parallel to that on the front, to shew the necessary thickness of the mahogany, and proceed as follows:

Let the stuff be sawn out broad enough to plane to *bo*; after which, plane it true on both sides, and glue on deal of the breadth of *ep*, and thick enough to make out the whole spring of the cornice. After the glue is dry, plane the mahogany to the exact breadth of *bv*. After striking a square line across the mahogany, extend the compasses from *a* to *a*, and to *c, f, g, &c.* and lay all these points on the square line, and run a gage thro' each of them. Run then a gage from *a* to *b*, and from *n* to *o*; and taking a bevel, fix the handle of it exactly by the front line, and let the inside of the blade of it correspond with *op*. With the bevel thus fixed, plane down the wood behind till it fit the bevel in every place, and be brought down to *o*. Take

then a square, and plane down the wood at *b* and *e* till the square fit in every place, and the wood is brought down to *b*. After this lay the cornice on the side *op*, and shoot off the wood *a, a, b*; then lay it on the side *be*, and shoot off the wood at *no* to *m*. The cornice being thus properly sprung, fasten it down on the side *ap*, and proceed to rabbet out the several squares. Begin at *c* and rabbet down to *f*; at *b* run on a side gage, and, entering in by a snipe's-bill, work down to *i*, the fluting being laid on afterwards; at *q* run on a side gage each way for the square of the oval. From *i* rabbet down to *k*, and at *l* down to *m*; and thus it is evident that the whole cornice, of whatever kind, cannot fail of being correctly worked.

Of the Method of contracting and enlarging Cornices.

SUPPOSE A to be a cornice already drawn or worked, and it be required to draw and work one a third, fourth, or any other proportion narrower than A, and, at the same time, to contract its projection in proportion to its height:

Take the compasses and extend them to *ao*, the whole height of the cornice A, and with this opening sweep an arch each way, and where they intersect, to that point draw right-lines from *o* and *a*, forming an equilateral triangle. In the same manner

manner proceed with the projection of A, as shewn in the figure. To the summits of those triangles draw lines from the several heights and projections of each member. If the cornice to be drawn is to be one third less, then divide any one side of the triangles into three equal parts, and take one part from o to p , and let fall a perpendicular from p ; and from where this perpendicular cuts each line draw parallels, which will give the height of each member in exact proportion. For the projections: $o q$ is one third of the side of the triangle, as before; draw a parallel line at q , which will give the several projections sought. Take $q t$, and transfer this to $p r$, and so of the rest, till you have laid on each projection; after which let fall perpendiculars, as shewn at No. 7, and proceed to draw the outlines of each member within their proper squares, and the cornice will be contracted in the most accurate manner.

Of enlarging Cornices.

SUPPOSE now the cornice A is required to be higher than what it is at present. Draw parallel lines from each member, and having fixed the compasses to the height proposed, fix one foot at o , and move the other till it touch any where on the line $o k$, as at k ; draw a line from c to k , and where this line intersects with each parallel before drawn, will be the several heights

of the mouldings as required. To find the projection, proceed thus:—sweep the arch ac , cutting ok at b ; take ab and place it from c to d , and from d draw a line to o , and om will then be the whole projection of the cornice proportionable to the height ok ; consequently where the line om intersects, each perpendicular raised from the several projections of A , will be the several projections sought. om is then a scale line for the projections, and ok for the heights of each member; and having these, the cornice can then be drawn on a separate paper, in the same manner as A was drawn at first.

By continuing the parallel lines of A to the right, as shewn in the plate, and by letting fall its perpendiculars to any length, it is evident that A may be enlarged as much as we please, by drawing the line ok more oblique, as at e , which then makes it rather more than one third higher. Then, by extending the compasses from a to where oe cuts the arch, and by replacing this opening from c to g , and striking a line from o to g through to f , of will be its projection as before; on which principles of will be in a ratio with oe . This the workman can prove, for by comparing of with the length of the projection of A , he will find it rather more than one third longer; and by comparing oe with oa , he will find it rather more than one third longer also.

Thus it is evident that any cornice or moulding whatever, and however complex, may be contracted and enlarged as we please, and that with the greatest mathematical nicety.

Of the Lady's Drawing and Writing Table. Plate LX.

THESE tables are finished neat, either in mahogany or satin-wood, with a brass rim round the top part. The upper part is made separate from the under part, and fixes on to it by pins.

The rising desk in the middle may be made to slide forward *, which will then serve to draw upon; and the small drawers below the coves at each end, will be found convenient for colours.

The drawer in the middle of the front serves to put the drawings in.

The top is lined with green leather or cloth..

The scale shews the size of every part in the front, and the breadth is two feet three inches.

The height of the upper part is eight inches..

* See the directions given for the Kidney Table.

Of the Dining Parlour. Plate LX.

THIS method of representing a dining or drawing-room has its advantages; though the most general method is by a plan and section, as the drawing-room in Plate LXI. In this method the end wall nearest the eye is supposed to be laid level with the floor, without which the inside of the room could not be seen. The advantage of this is, that the walls, furniture, and every particular, are shewn in their natural position, except the first end, so that the effect of the whole may be better judged of than in the other method.

The advantage of the method in Plate LXI. is, that the sides and ends of the room being turned down, from a geometrical plan, every thing on the walls is shewn geometrically, and therefore the parts are more distinct; but with this disadvantage, that it must be viewed at four different times, by turning each end and side to the eye; whereas, in the other way, the whole is seen at one view.

In proceeding to draw after the method of Plate LX, make a scale of feet as there shewn, and draw G R for a ground line, and H L for the horizon. Let the center of the picture be in the
the

the middle of the end; and, as these are views of a short distance, extend the compasses from the center to *o*, and turn it up to *d*, which will be the shortest distance that can be applied. Draw visuals from *o*, *c*, *b*, *a*, to the center. From *o* to 1 lay on the size of the first pier, and draw a line to *d*, which, cutting the visual drawn from *o* to the center, gives the perspective of it. Then lay from 1 to 2, the breadth of the window, and draw a line to *d*; and in like manner find the appearance of all the piers and windows. Observe, that a line from R to *d* finds the whole length of the room. How every other part must be drawn will be obvious to every one who understands perspective, and no other with any propriety can attempt it.

This dining-parlour gives a general idea of the Prince of Wales's in Carlton House; but in some particulars it will be a little varied, as I had but a very transient view of it.

The Prince's has five windows facing St. James's Park. This also has five, one of which is hid by the left column. His windows are made to come down to the floor, which open in two parts as a double door, leading to a large grass plat to walk in. If I remember right, there are pilasters between each window; but this is intended to have glass. In his is a large glass over the chimney-piece, as this has. To these glass frames are fixed candle-branches. At each end of his is a large sideboard, nearly
twelve

twelve feet in length, standing between a couple of Ionic columns, worked in composition to imitate fine variegated marble, which have a most beautiful and magnificent effect. In the middle are placed a large range of dining-tables, standing on pillars with four claws each, which is now the fashionable way of making these tables. The chairs are of mahogany, made in the style of the French, with broad top-rails hanging over each back foot; the legs are turned, and the seats covered with red leather.

I could not shew the curtains of each window without confusion, but they are of the French kind.

Many dining-rooms of the first nobility have, however, only two columns and one sideboard; and those of less note have no columns.

The general style of furnishing a dining-parlour should be in substantial and useful things, avoiding trifling ornaments and unnecessary decorations. The pillars are emblematic of the use we make of these rooms, in which we eat the principal meal for nature's support. The furniture, without exception, is of mahogany, as being the most suitable for such apartments.

Of the Drawing Room. Plate LXI.

IN drawing a room of this kind very little perspective is wanted. All that is required is a horizontal line on each wall. And I would not advise drawing every object on each wall to one point of sight, as those at the extremities will thereby become exceedingly distorted and unnatural. For, upon supposition that the spectator moves along to different stations as he views any one side of the room, perspective will admit that the designer have as many points to draw to as the spectator had stations to view from. If a room of this sort be narrow, fewer points may do for the furniture at each end, with a little management; but the furniture on the side walls should have almost as many points as pieces of furniture. The line that marks out the boundaries of the floor, serves as the proper ground line to each horizon, and the geometrical measurement of each piece being taken from the scale and laid down on the wall, the perspective is drawn from each point backwards, or into the room.

A drawing-room is of that sort which admits of the highest taste and elegance; in furnishing of which, workmen in every nation exert the utmost efforts of their genius.

To assist me in what I have here shewn, I had the opportunity of seeing the Prince of Wales's, the Duke of York's, and other noblemen's drawing-rooms. I have not, however, followed any one in particular, but have furnished my ideas from the whole, with such particulars as I thought best suited to give a display of the present taste in fitting up such rooms.

It may not be amiss to mention some particulars respecting the Prince's room, that the reader may form some idea of its taste and magnificence.

Its proportions are as follows:—forty-eight feet six inches long, thirty-four broad, and between eighteen and nineteen feet high, including the cove of the ceiling.

It has five windows in length, a fire-place at each end, and five doors. Two doors are at each end, one of which is sham; and a large arched double door nearly in the center opposite the windows.

Opposite each window is a large glass, with a circular top, to suit the arches above the windows; and over each fire-place there is also a glass. In the piers between each window there are no glasses, but a couple of richly finished Corinthian pilasters, with their architrave and imposts to suit the tops of each window.

window. On the side opposite to the windows the same pilasters are employed; for, as the before-mentioned glasses each occupy a space equal to the width of a window, and are directly opposite to them, this preserves a regularity in the pilasters on both sides. In like manner each end of the room has its pilasters of the same order, one on each side of the fire-place, and of the doors. The cove and ceiling are richly ornamented in paintings and gold.

A room of this description is not, however, a proper precedent for drawing-rooms in general, as it partakes principally of the character and ordinance of a state saloon-room, in which are entertained ambassadors, courtiers, and other personages of the highest stations.

In the drawing-room which is here shewn, every thing will appear easily understood to a workman in town, who is accustomed to see such apartments; but for a stranger, and those workmen who reside in the country, it will be proper to point out a few particulars.

The pier tables have marble tops and gold frames, or white and gold. The glasses are often made to appear to come down to the stretcher of the table; that is, a piece of glass is fixed in behind the pier table, separate from the upper glass, which

then appears to be the continuation of the same glass, and, by reflection, makes the table to appear double. This small piece of glass may be fixed either in the dado of the room, or in the frame of the table.

The arches above the windows are merely artificial, being only wooden frames put up, strained with canvas; after which the same kind of stuff which the curtains are made of is formed to appear like a fan, and drapery tacked on to it.

The pannelling on the walls are done in paper, with ornamented borders of various colours.

The figures above the glasses are paintings, in clare-obscure. The sofas are bordered off in three compartments, and covered with figured silk or satin. The ovals may be printed separately, and sewed on. These sofas may have cushions to fill their backs, together with bolsters at each end. In France, where their drawing-rooms are fitted up in the most splendid manner, they use a set of small and plainer-chairs, reserving the others merely for ornament.

The commode opposite the fire-place has four doors; its legs are intended to stand a little clear of the wings; and the top is marble, to match the pier tables. In the freeze part of the commode is a tablet in the center, made of an exquisite composition

position in imitation of statuary marble. These are to be had, of any figure, or on any subject, at Mr. Wedgewood's, near Soho-square. They are let into the wood, and project a little forward. The commode should be painted to suit the furniture, and the legs and other parts in gold to harmonize with the sofas, tables, and chairs.

To supply the Defect of Figure 32, Plate V.

It is there shewn how to find the miter of the sides of a comb-tray at any pitch, and of any given projection; but it was omitted to shew how the miter is obtained in the thickness of the stuff, as it rises to any pitch.

Having found the breadth of the sides bc , Fig. 32, Plate V, with this opening of the compasses describe a semicircle, see Plate XXII, and make ae equal to the perpendicular height of the side of the tray. Draw a line from e to the center; and parallel to this, set off a line for the thickness of the tray sides, and the bevel of the under edge will be at 4. Draw a square at the center, the length of whose sides shall be equal to the thickness of the tray sides, as 3, 1, 2. Next draw the line B, A, E , parallel to the diameter; and take ae , the sine of the angle of the tray sides, and transfer it to EA . From A draw a line to the center, cutting the small square at 1, and the space 1—2 will be the miter sought for; that is, when the sides are mitered in their

their breadth, according to Fig. 32, Plate V, set a gage to 1—2, and run the gage along the miter, and plane it off to the gage from the outside, and the miters will all come exactly together. If the tray sides were raised to *b*, *b i* would then be the sine of their angle; and which being transferred to B, a line from B to the center cuts the square at 3; then is the space 3—2 the length of the miter sought. And thus it is evident, that as *b* advances to E the perpendicular, so will the miter point B approach to D, the full miter. It is also evident, that by this figure the miter of any thing not exceeding the diameter E of the semicircle may be found. For instance, if the sides of any tray be half an inch thick, and it is required to be mitred and keyed together, draw a square of that dimension, as the second shewn in the figure; and if the sides bevel in an angle equal to the line *e*, then 1—2 of the second square will be the length of the miter. I proved the truth of this theory by practice, and therefore the workman may depend on its infallibility; but he may easily make the same experiment himself.

T H E E N D.

E R R A T A.

- Page 23, line 14, for *bs*, read *b S*.
 — 28, — 13, *read it thus*:—if you want five tenths of a foot, and five of the hundredth parts of a foot, place your compass foot—
 — ib. — 19, for any tenth part of an inch, *read* any one hundredth part of a foot.
 — 57, — 16, for 9, 5, *read* 9—5.
 — ib. — 18, for 9, 5, *read* 7—5.
 — 61, — 11, for *a* to *n*, *read* *d* to *n*.
 — 70, — 9, for the extreme line *PE* and *P I*, *read* *PE* and *I I*.
 — 137, — 4, for abacuo, *read* abacus.
 — 152, Plate VIII, for 7 diameters, *read* 8 diameters.
 — 162, line 22, Plate XII, for take *m o*, *read* take twice *m a* in the compasses, and with this opening find the center of the curve for the abacus as at *p* on Fig. B.
 — 206, — 10, for from *a* to *a*, *read* from *d* to *a*.
 — 211, — 11, for Plate XV. *read* Plate XIV..
 — 273, — 15, for Fig. 23, *read* Fig. 21.

APPENDIX
TO THE
CABINET-MAKER AND UPHOLSTERER'S
DRAWING-BOOK.

CONTAINING
A VARIETY OF ORIGINAL DESIGNS FOR HOUSEHOLD FURNI-
TURE, IN THE NEWEST AND MOST ELEGANT STYLE;
ALSO,
A NUMBER OF PLAIN AND USEFUL PIECES, SUITABLE EITHER FOR
TOWN OR COUNTRY;
TOGETHER WITH A DESCRIPTION AND EXPLANATION TO EACH PIECE.

BY
THOMAS SHERATON,
CABINET-MAKER.

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A P P E N D I X.

Of the Elliptic Bed. Plate I. of the Appendix.

As fancifulness seems most peculiar to the taste of females, I have therefore assigned the use of this bed for a single lady, though it will equally accommodate a single gentleman.

The elliptic shape of the frame of this bed contracts its width at each end considerably, on which account it will not admit of more than one person.

On the manufacturing part of it I would offer a few hints to assist the workman.—The frame of the bedstead should be glued up in wainscot three or four thicknesses, with the jump-joints crossing each other, as in the method of gluing the frames of circular card-tables, which some use. For which purpose, draw the full size of the ellipsis upon a board, and make the diameters each way, by which one quarter will be found.

found. A thin mould must then be made to agree with the quarter of the ellipsis, which will serve for cutting out the whole by, when different portions of it is so taken as to form crossing-joints. The frame being thus made an entire ellipsis, as Fig. A, in Plate XXX. it is proposed to half-lap the pillars into the frame, and to have a stretching rail at each end to tenon in opposite to each pillar; into which stretcher the screws are to work which fix the pillars to the frame, as shewn at *a, b, c, d*, in Fig. A. The workman will easily see that the frame made in this manner will not be defective in strength, nor inconvenient to move from one room to another.

The stuffed head-boards at each end are framed separate, and grooved into the pillars, with a tenon in their center to slip into the bed-frame, which can be easily done when the pillars are screwing to.

The first tester which fixes on the pillars, should form an entire ellipsis to suit the frame, and must be glued up in two thicknesses of good deal or wainscot; to the edge of which should be glued two thicknesses of clean soft mahogany, of which to work the cornice, as expressed by Figure B, in Plate XXX.

The second, or false tester, is that to which the ribs of the dome part are fixed, as *e* in Fig. B; and *f* is an architrave which is bent round the inside of the first tester, and rises so high above it as to receive nearly the thickness of the false tester; so that the architrave is a guide to the whole dome, and is sufficient of itself to keep it firm in its place.

With respect to the dome, it will be best to make it in two parts. The cove part separate, and the round or spherical part separate. This can easily be done, by repeating the same operations as were necessary for fixing and managing the cove part; for it must be observed, that there is a light cornice or moulding where the circular part of the top begins, and which fixes on a tester in the same manner as the other. To the under side of this cornice is the drapery, which hangs in the cove, tacked all round, as is the valence to the under cornice. The curtains are drawn up by pulleys fixed in the under tester, and thus forms a drapery, by being tied to the pillars with cords.

The circular part of the top is intended to be pannelled out in gilt mouldings, which cannot fail of producing a fine effect, particularly so if the furniture and covering of the dome be light blue. The foliage ornament that runs round the under cornice may be made either of composition metal, or it may be cut in

wood and fixed on wire, in the same manner as the tops of ornamented glasses are managed.

Of the Duchesse.

THE French have what they term duchesse beds, whence I suppose we have derived our ideas of a duchesse. What is sometimes named a duchesse amongst us, is merely two barjier chairs fastened to a stool in the middle; sometimes, indeed, we add a slight tester and covering, but even this is very different from theirs. The French duchesse beds are more stately. The tester is full and fixed to the wall, with drapery hanging down to the bedding and floor. The head part is formed something like the back of a chair; at the foot there are short stump pillars; and the whole frame of the bed being detached from the tester, may be moved to any part to loll upon. The duchesse which is here given, is intended to answer three different purposes. The ends, when detached from the middle stool, may serve as small sofas. When they are connected together without the tester, and a squab or cushion made to fit over the whole, it will then serve to rest or loll upon. When it is used as a bed, four short pillars are screwed to each back foot, and a straight lath extends across from pillar to pillar at each end. From these pillars are fixed the sweep iron rods which form the tester, and which support the

the

the drapery and covering which is thrown over the whole. The little dome or top is made separate and entire of itself, with the cornice mitered round, and the tassels fixed to it as shewn in the design, and the whole is placed loose on without any fastenings.

They are made narrow, between two and three feet wide, and seldom above it. Every thing is made exceeding light about the tester. The stool is fixed to each chair with straps and buttons, and the whole thus finished makes a pleasing appearance.

Of the Library Case. Plate III. of the Appendix.

THE elliptic breaks of this bookcase will produce a good effect in the whole.

The doors in the upper part are intended to have fluted green silk behind, and a drapery at top.

The pilasters are supposed to be glued to the stile of the door, and are hinged as in common.

The lower middle part contains clothes-press shelves, and every other part may be fitted up for books; or the lower elliptic

tic

tic breaks may be formed into a nest of drawers, as there is depth enough.

The half columns on the lower doors are glued to the stile, and the doors hinged as in common; but for the sake of shewing the design to advantage, the open door is drawn as if the columns were separate.

The young workman should observe, that the whole is to be made in fix carcases, and screwed together, and then the plinth should be made to fit it, of one entire frame; also the furbace and its freeze are made all in one frame, and screwed down on to the carcases; as also is the cornice and its freeze.

Of the Pier Tables. Plate IV.

As pier tables are merely for ornament under a glass, they are generally made very light, and the style of finishing them is rich and elegant. Sometimes the tops are solid marble, but most commonly veneered in rich satin, or other valuable wood, with a cross-band on the outside, a border about two inches richly japanned, and a narrow cross-band beyond it, to go all round. The frames are commonly gold, or white and burnished gold. Stretching-rails have of late been introduced to these

tables, and it must be owned that it is with good effect, as they take off the long appearance of the legs, and make the under part appear more furnished; besides they afford an opportunity of fixing a vase or basket of flowers, which, with their reflection when there is a glass behind, produce a brilliant appearance.

Some, in place of a stretcher, have a thin marble shelf, with a brass rim round it, supported by a light frame; in which case the top ought to be of marble also.

Of the Library Steps and Table. Plate V.

THIS design was taken from steps that have been made by Mr. Campbell, Upholsterer to the Prince of Wales. They were first made for the King, and highly approved of by him, as every way answering the intended purpose. There are other kinds of library steps which I have seen, made by other persons, but, in my opinion, these must have the decided preference, both as to simplicity and firmness when they are set up. The steps may be put up in half a minute, and the whole may be taken down and enclosed within the table frame in about the same time. The table, when enclosed, serves as a library table, and has a rising flap, supported by a horse, to write on. The

size of the table is three feet ten inches long, thirty-three inches high, and two feet one inch in width. When the steps are out they rise thirty-three inches perpendicular from the top of the table frame, and the whole height of the last step is five feet five perpendicular from the ground. The perpendicular height of the hand-rail is three feet one inch above the last step; and observe, that on *g*, which is iron, is fixed a small flap on which a book may rest, so that a gentleman, when he is looking at any book in his library, may note down a passage from it without the trouble of going down again. The method of folding the whole up is as follows :

The triangular iron bracket *g* is unlocked by a catch which keeps it firm to the hand-rail, and the desk-flap fixed to it being turned over to the inside, the whole comes forward, and lies level upon the upper steps. The standard *b* may then be raised out of its socket, and, having a joint at the top, it turns up to *d*, as shewn by the dotted curve line. The short standard *de* is then, by relieving a spring, pressed down below the edge of the table-top; and the hand-rail and standard *b* having been folded together, as mentioned before, they both rest on the iron socket fastened to the front edge of the upper steps. Next, the horse *o* is folded by the side of the upper steps, and then both they and the horse fall down within the table frame; and it must be observed, that in folding

ing

ing down the steps, the hand-rail and standard, which rested for a while on the socket fastened to the front of the steps, fall into another socket of the same kind fastened to the under side of the table top, where they remain, and fall within the table frame when the top is folded down. Lastly, the lower steps *a* are turned up to a horizontal position, and being hinged to a slider which runs in a groove, the whole flips in as a drawer, and is enclosed by the flap *p*, which turns up and appears as the front of a drawer.

Of the Drawing-room Chairs. Plate VI.

THE frame of the right-hand chair is intended to be finished in burnished gold, and the seat and back covered with printed silk.

In the front rail is a tablet, with a little carving in its panel. The legs and stumps have twisted flutes and fillets, done in the turning, which produce a good effect in the gold.

The chair on the left may be finished in japan painting, interspersed with a little gilding in different parts of the banister, which has a lively effect. The covering of the seat is of printed
5 chintz,

chintz, which may now be had of various patterns on purpose for chair-seats, together with borders to suit them.

Of the Bidet Dressing-Table, and Night-Table Basin-Stand.

Plate VII.

THE dressing-table has a real drawer under the cupboard part, and the rest are sham.

The right-hand cupboard door opens by a spring-catch communicated to the patera handle in the center. The water-bottle is supported by a round box, made of very thin wood, glued and canvassed over to strengthen it, and fixed to the top.

The bidet legs turn up with a joint. The design shews only legs at one end, but the other legs are supposed to be folded up till the whole is taken out; and when used, the legs are kept to their place by iron hooks and eyes.

The scale shews the size of the front, and its depth from front to back is sixteen inches and a half. The frame, to which the glass is hinged, is fourteen inches in width.

The night-table requires no explanation, and I shall only observe, that the covers with rings on them are meant for
a tooth-

a tooth-brush, and the ivory boxes on the right for tooth-powder.

The scale for the dressing-table shews the size of the night-table, applied to the front, and its depth from front to back is eighteen inches.

Of the Wardrobe. Plate VIII.

THE upper middle-part contains six or seven clothes-press shelves, generally made about six, or six inches and an half deep, with green baize tacked to the inside of the front to cover the clothes with. The lower part consists of real drawers. The wings have each of them arms, to hang clothes on, made of beech, with a swivel in their center, which flips on to an iron rod fixed by plates screwed on to each side of the wings, as expressed in the design.

The whole is made in four separate carcasses. The wings by themselves, and the upper and lower middle parts separate.

The plinth is made all in one frame, and likewise the cornice with its freeze, and being screwed to each carcass, the whole is kept firm.

Observe, that in the wings a bead is put up for the doors to fall against when they are shut to; by which means are cleared the knuckles of the hinges on the doors of the middle part.

It should also be observed, that as the furbace cannot go round the out ends of each wing on account of opening the doors, the moulding is returned against the front of each door.

The furbace on the middle part returns, and stops against the inner end of the wing; and the edge of the door of each wing, with the furbace which is on them, are scribed on to the aforesaid return, which then appears as an internal miter, and gives place to the opening of the door.

The scale, applied to the middle part, gives its height and length. The wings are two feet, and sixteen or seventeen inches deep; and the depth of the middle part about twenty-three inches.

Of the Bed. Plate IX.

THIS design requires no explanation, except that which relates to the tester. The cove of the tester is to be formed by

ribs; one at each miter, and other short ones joined to them, with the rest about five inches apart from each other. At the upper part of the cove is a square tester into which the ribs are fixed. On the edge of this tester, which is made very light, is fixed a small moulding mitred all round. The cove being formed, the ribs may be covered with strong board-paper, both inside and out, which may either be japanned to match the furniture, or it may be covered with the furniture itself. The circular part about the cove is nothing more than a straight board fixed on to the upper tester. For the sake of easy conveyance, the cove may be made in four parts, mitring at each corner, and the ornament intended to be at each miter on the outside running entirely up to the feathers, will hide the joint.

The swags of silk line that appear on the drapery should be fastened to the back part of the cornice, in order that they may hang easy. The pillars are to be japanned. The pannel that hides the screws is made to slip into a groove at the bottom, and when raised up a little from their place, can be taken away to come at the screws. The valence and drapery both together slip on to a lath as in common.

Of the Sofa and Conversation Chairs. Plate X.

WITH respect to this sofa, all that is necessary to be observed is, that in the space between the divisions of the back part, it is meant that there should be a ground-work covered with silk, to suit the rest of the sofa. Against this ground the two columns and the ornament are supposed to rest.

The conversation chairs are used in library or drawing-rooms. The parties who converse with each other sit with their legs across the seat, and rest their arms on the top rail, which, for this purpose, is made about three inches and an half wide, stuffed and covered.

For the convenience of sitting in the manner just mentioned, the chair is made long between front and back, and very narrow at the back and front in proportion. The height of the chair to the stuffing is three feet; at the back ten inches; spreading out in width to the top rail, which is twenty inches in length. The front is sixteen inches, and the height of the seat as in common.

Of the Card Tables. Plate XI.

ON these tables it is scarcely necessary to say any thing, especially as the quarter plans shew how they must be framed; and therefore I shall only observe, that the ornaments may be japanned on the frames and carved in the legs. As to the method of managing the tops, I take it to be the best to rip up dry deal, or faulty mahogany, into four inch widths, and joint them up. It matters not whether the pieces are whole lengths, provided the jump-joints be crossed. Some tongue the jump-joints for strength.

After the tops are dry, hard mahogany is tongued into the ends of the deal, then slips are glued on the front and back, that the whole may appear solid mahogany, if a moulding is to be worked on the edge; but if the edge be cross-banded there is in this case no need for tonguing in mahogany.

Of the Library Table with a Writing Drawer. Plate XII.

THIS table is intended either to sit or stand and write at. The height of the secretary-drawer is adjusted for sitting, and

the top of the table is high enough to stand and write on, especially if the middle top be raised by a horse, as shewn in the design. This table will also prove very useful to draw on; for when the middle part is up for drawing upon, there remains sufficient room at each end of the table on which to place the necessary impliments for drawing; besides, the drawers at each end may be fitted up to hold colours of various kinds; I mean the two upper ones, for there are drawers quite down to the plinth. The drawers under the secretary will hold the large sheets of drawing-paper, together with the tee squares; and as it will not be necessary to make the drawers under the secretary the entire width of the table, the opposite front, being made sham to have the same appearance, the whole of it may be hinged at bottom and locked at the top, and the inside will allow depth for books. This sham front being a considerable width, it would hazard the hinges to let it rest wholly on them when turned down, and therefore there should be iron rule-joints at each end as stays.

To these conveniences there are also four cupboards inclosed with doors, as shewn in the design, and the whole finished in this manner, I venture to affirm, will prove as useful a table as has ever been devised or published.

In respect to the manufacturing part, it will be best to make it in two parts. The upper part containing the secretary, and two drawers at each end; and the lower part, four drawers under the secretary, a book-case behind, and four drawers at each end, the lowermost of which is shewn in the design. The top should be framed of inch and quarter wainscot (as described in page 373), containing a well for the desk part, which may be made to rise on the front as well as at the back, by forming a double horse; but in this design it is only intended to rise at the back by a single horse, and hinged to the cross-band at the front.

The cupboard doors may either be framed and pannelled, or glued up to their sweep in narrow slips of inch mahogany, and clamped; not by tonguing, but by a square joint, and pins driven through the clamps.

The management of the circular base-moulding and plinth may be learned in page 375.

Of the Fire Screens. Plate XIII.

THE lyre screen is constructed upon an entire new plan, it being designed to turn upon a swivel, which fixes to the vase and

and passes through the bottom rail, so that the screen may be turned to any position without moving the stand.

The screen part, which rises between the standards or pillars, is suspended by a weight in the tassels, which are communicated to the screen by a line passing through the pillars and over a pulley fixed to their top.

There must be a dovetail groove in each standard, and the screen made to fit into these; so that the standards may keep their proper place, and not fly open at the top.

Observe, that the ornament on the tops of the pillars or standards rise up with the screen, being fixed to it, and detached from the pillars.

It is intended that the lyre ornament be carved in bas relief, gilt and burnished; which, when planted on to a blue silk or satin ground, cannot fail to produce a fine effect.

The other screen being common, needs no explanation, only that it is suspended by little springs fixed in the dovetail grooves of the standards.

In respect to the general size of horse fire-screens, about eighteen inches or nineteen may be allowed for the breadth, and three feet six or seven inches for their height.

Of the Cabinet. Plate XIV.

THIS cabinet, I presume, is as new as the fire-screen, and will have a better effect in the execution than in the design.

The front of the cabinet is hinged to a sliding piece which runs in a groove, upon the same principle as the writing-table page 408. The front being turned down to a horizontal position, it may then be slipped in till it stops. To support the front thus turned down, there are two sliders which come out of the plinth on which the cabinet rests. These sliders come out by relieving a spring which is fixed in their side, and having a common spring behind, they are forced out so that the fingers may lay hold to draw them quite out. They are lined with green cloth both at top and bottom to prevent scratching. The inside of the front is also lined with green cloth to write on. The inside of the cabinet is fitted up in the manner shewn in the cabinet Plate XVI.

Above the falling front is a drawer, to the under side of which the front locks, so that the drawer and front are either locked or opened at one time.

Above the drawer is an ornamented freeze, japanned; and round the top, which is marble, is a brass edging.

The flower-pot at the top is supposed to be real, not carved; but that on the stretcher is carved.

The columns stand clear, as shewn by the plan; and they are intended to have brass bases and capitals, with wooden shafts fluted.

The candle branches turn to any form in a socket, and the whole may be taken away, as they are only screwed into a nut fixed into the legs of the table.

There is a brass fret fixed at each end, which finishes at the standards of the candle-branches. The lower frame contains a drawer in front, and the legs being octagon, are intended to be veneered crossways as far as to the carving, which may be gilt to suit the bases and caps of the columns.

Of the Dressing Chests. Plate XV.

THESE chests are also on a new plan, particularly as the common slider for merely writing on is turned into a shallow drawer, which contains a little writing flap which rises behind by a horse, and places for ink, sand, and pens, and also dressing-boxes. When the drawer is in, it appears like a common slider, with a partition above and below, as that with the convex front. There is therefore no flip under the top, as the drawer sides must run close up to it. The drawer below of course must lock up into the under edge of the dressing-drawer, and the dressing drawer into the top, which is done at one time, by the bolt of the under lock forcing up that of the upper one.

The height of these chests are always governed by the slider, which runs thirty-two or thirty-three inches from the floor. The scale shews their length, and their breadth is twenty-two or twenty-three inches.

Of the Lady's Cabinet. Plate XVI.

THE cabinet in Plate XIV. is made in two parts, but this is entirely in one. The legs and columns are therefore all in one
piece

piece. The inside of the cabinet is made separate, and flips in between the legs, and a piece of narrow wood, as a band, is fitted to fill the space up to the column, as the design shews.

The marble shelves, with frets at each end, are for a tea equipage. Above and below these shelves are drawers which turn out by a hinge. Above and below the front are also drawers. The drawer below may be made to support the front when turned down to write on, or it may be supported by brass joints, as shewn in the design for the inside of the cabinet.

The scales and plans of each cabinet shew their length and breadth; it remains only to mention their height, which is four feet, and four feet two.

Of the Horse Dressing Glasses. Plate XVII.

THE dressing-glass on the left rises to any height, by lead weights inclosed in the standards. The weights are suspended sometimes to tambour glued on to webbing, which passes over a brass roller at the top, and fixes to a piece of thin wood, tamboured to match it. Through this piece of thin wood is put an iron pin, with a thin plate to it to screw it fast; which pin goes through the side of the glass, and fastens by a nut at the inside,

so that when the glass is raised, it may be turned to any direction. But some use a kind of coloured strong webbing, without the tambour, which makes it less troublesome, and less liable to injury, though it does not look so neat. Those unacquainted with the manner of gluing up the standards, may see a section of them in Plate XXX. Fig. C.

There is a brass handle behind the ornamented top to raise the glass by.

The boxes on each side are intended to hold conveniences for dressing. On these, there is a comb-tray on the left side, and a pin-cushion on the right. When the dressing-boxes are not in use, they are intended to turn behind the glass. For this purpose they are fixed to a brass socket, which turns upon a short brass rod, and by a screw they may be raised up or lowered at pleasure. See Fig. D. Plate XXX.

The other dressing-glass has a convenience for writing as well as for dressing, which convenience rises by a little horse. The dressing-boxes are made with close covers, and a slider incloses the whole, so that when the whole is turned up nothing can come out of its place. The glass does not rise as the other, but fixes in centers, so as to move in any position either back or forward.

And observe, that when the dressing-flap is turned up it locks into the top rail, and the glass of course falls to its own place. The under side of the flap being the front when turned up, it may be japanned and banded. The lower parts of the standards are shaped like a lyre; and to form the strings, brass wire is let in, which has a pretty effect.

Of the Chaise Longue. Plate XVIII.

THESE have their name from the French, which imports a long chair. Their use is to rest or loll upon after dinner, and in some cases the lower one will serve for a sofa. The drapery under the rail is tacked to a rabbet left on purpose. The upper one is framed first in two parts. The end, or chair part, is made to receive the stool part within its sides; and the sides of the stool part screw in against the inside of the chair. As to any other particular, the designs themselves are sufficient to point them out.

Of the English State Bed. Plate XIX.

IN giving a design for an English state-bed, or such an one as is suitable to the dignity of a prince, and worthy the notice of a king, I conceived it necessary to cultivate as much as I could
the

the most exalted ideas, unfettered and unrestrained with the thoughts of expensiveness, which naturally produces meanness of composition, and in many cases injures the ingenious in their designs.

For ornament to a bed of this kind, it struck me that nothing could be more suitable and characteristic than such as expressed symbolically the different parts of our government, together with those virtues and principles which ought to be the support of regal authority, and the ruling maxims of every good government of whatever kind, whether monarchical, aristocratical, or democratical. Emblems of war have been avoided as much as possible, being inconsistent ornaments for a bed, and because good kings ought not to delight in war, but in peace, unity, and the love of men and their subjects.

As our government is composed of three distinct branches, the figure on the right hand bed-pillar is intended to represent the democratic part of it, or the power of the people invested in their representatives in parliament.

In iconology*, democracy† is represented by the figure of

* Iconology, from *εικον*, *eikon*, an image; and *λεγω*, *lego*, I speak. The interpretation of ancient images, monuments, and emblems.

† Democracy, from *δημος*, *demos*, people; and *κρατειν*, *krátein*, to command or govern; is when the sovereign power is lodged in the body of the people.

a woman

a woman dressed in a homely garment, and crowned with vine leaves. In her right hand she holds a pomegranate, which denotes assemblies of the people on matters of importance. In her left hand is a cluster of serpents, which expresses the winding and slow progression of democratic states, owing to the inability of the common people to govern. Her standing on the two sacks of corn which rest on the pedestal, signifies that democratic government is more attentive to the obtaining of necessary provisions, than the increase of fame, or the acquisition of honours. If this be a just representation, and founded on fact, the reader will, no doubt, consider the democratic branch a very important one, and for which reason it is here placed near the groundwork.

The figure, opposite, on the left pillar, represents the aristocratic branch. Aristocracy* is described by the figure of an elderly lady, in a sumptuous dress, with a crown of gold upon her head. Painters represent her sitting on a throne; which is a position consonant to lawgivers, but which I could not make suitable to this situation. In her right hand she holds the consular fasces, that is, a number of elm rods tied in a bundle, with a hatchet in the middle, which, originally, were the ensigns of

* Aristocracy, from *αριστος*, *aristos*, the best; and *κρατος*, *kratio*, I command or govern; is when the supreme power is lodged in a senate, composed of the principal persons of a state, either for their nobility, capacity, or probity.

sovereign dignity, but in after times the hatchet was taken out, and they were carried before the consuls or magistrates of Rome, to denote their authority. These rods are entwined with a crown of laurels, a symbol of reward due to those who have maintained the public welfare, and have performed great actions for the good of the state. In her left hand is a steel cap, at her feet a hatchet, a plate, and purse with money, all which denote that arms and finances are necessary supports of states. And I would here observe, that it is not absolutely necessary to consider the steel cap and hatchet as symbols of war, but of the executive power requisite in all governments for the maintenance of peace, and the punishment of evil doers.

The figure in the center of the upper cornice is intended to represent the monarchical branch of our government.

Monarchy* is characterized by the figure of a young woman of grave countenance, seated on a terrestrial globe, holding four scepters, to denote dominion and power. The other hand being uplifted, denotes her authority in giving command. The rays of light surrounding her head, denote lustre, and the respect due to her greatness. The lion on each side symbolizes the

* Monarchy, from *μονος*, *monos*, alone; and *αρχη*, *arche*, government; is when the supreme power is invested in one person, commonly termed the King.

power which she possesses and requires of others in order to her support. Painters, however, describe her with trophies of war, and a crowned head chained down as a captive at her feet, which I have here omitted, hoping that conquest and war are not the prominent features in our government.

These three figures in their situation to each other form a triangle, whose base is democracy and aristocracy, and whose summit is monarchy ; denoting that monarchical power and honour are originally derived from the people, and that without their support, monarchy in its most exalted state must fall.

The lions which support the bed, with oak foliage and leaves on the bed-frame and round the shafts of each pillar, are emblems of the strength and permanent nature of our government. The acorns being the fruit of the oak, denote, that by long progressive improvements it is arrived to a good degree of maturity.

The serpents in the cornice, which mutually entwine themselves round Mercury's rod, denote the unity, prudence, and wisdom, requisite to monarchs in the exercise of their important charge. The trumpets and laural crown are expressive of the fame which the English state has acquired through the mildness of its government. The beads under the cornice de-

note

note its riches. The baskets of fruit on each capital, and in the quadrantal pannels, symbolize the prosperous state of the nation, and the plenty we enjoy. In the arch of each quadrant are marked the degrees, to denote that navigation has contributed greatly to our riches and safety. The lyre and trumpets on the pedestal above the cap, signify the flourishing state of the arts; and the spreading oak leaves and roses, are meant to express the designer's wish and hopes, that the useful arts may long continue to grow and spread themselves under the munificence of our government.

The coronets round the dome are those of the immediate sons and daughters of the king of Great Britain, of which there are thirteen; but the dome being divided into sixteen compartments, still leaves room for an increase of the royal family, to denote that the subjects of Great Britain should hope for a long succession of a mild and good government. The festoons of flowers denote that happiness and prosperity are wished to surround each branch of the royal offspring.

The crown of England is supported on the top of the dome by three figures, intended to represent Justice, Clemency, and Liberty; for notwithstanding these may, in some instances, be sullied in our government, yet scarcely any nation can boast of more than that which we have long enjoyed.

Justice, which ought to be the moving principle of civil government, is by painters described by the figure of a woman dressed in white robes; holding in her left hand a sword, to punish criminals; and in her right a pair of scales, to give that which is due to every one without partiality; which impartiality is denoted by a bandage over her eyes. In this situation the sword and scales may be supposed to lie on the other side of the dome ready for use.

Clemency is a necessary quality or principle in government, by which those in authority are enabled to take into consideration, and to effect the relief of the miseries of the helpless and insolvent. In the exercise of this virtue, he who is ready to be cut asunder by the uplifted hand of justice can be saved, and the rotting insolvent prisoner can be absolved and released. Such actions beget gratitude in the minds of the subjects, and are as a pillar to the crown; while cruelty and tyranny have often proved fatal to princes.

Painters describe this virtue by the figure of a woman crowned with olives, as a mark of her peaceful and gentle temper; and dressed in a purple robe, which denotes her eminence. She is characterised by the mildness of her countenance, and sitting on a lion (which I could not here introduce.) She also holds a laurel branch of honour and respect in her right hand.

She

She is said to have a spear by her side, so that when her mercy is abused she may in justice revenge it.

The other figure, Liberty, on the other side of the dome, is an essential principle to good government. It supposes a disposition in those possessing supreme authority to allow subjects to enjoy their natural, moral, and religious rights. In the possession of these we are delivered from slavery; the yoke is broken. Therefore painters represent liberty by the figure of a woman, with a broken yoke-stick in her left hand, and trampling upon it as a mark of resentment. She is dressed in white robes, to denote the blessings which she confers on mankind; and in her right hand she holds a sceptre as a sign of independence. She has also a cap of liberty on her head, in allusion to the custom of the Romans, in setting their slaves free; who also shaved their heads, and permitted them to be covered in the presence of those who gave them liberty*.

The figures on the other side, and at the end of the bed may be the same, not merely for uniformity's sake, but to convey the sentiment expressed by the allegory with more weight, as it is well known that repetition is some-

* Richardson's Iconology, from whose work I am indebted for several ideas on this subject.

times introduced to give force and energy to a subject. However, if any should think it necessary to vary the figures on the different sides, there are plenty of subjects suitable enough.

Fortitude may be placed on the center of the cornice, opposite to monarchy ; to denote a quality of mind so highly necessary in those who rule. The emblem of this quality is a woman resting on the shaft of a column and its base, having a brown robe and part of a military dress, with a lion on one side of her ; but she may have one at each side, to make the outline more agreeable to the figure of monarchy. Her military dress conveys the idea of courage ; and resting on a column, steadiness and firmness ; and the lion, strength of mind.

On the bed-pillar, opposite to the figure which represents the aristocratic branch of our government, should be Counsel, to denote the wisdom and ability necessary in those who make up that branch.

Counsel is represented by the figure of a grave old man, having a long beard, dressed in long robes of violate colour. His age denotes that experience requires length of time, and that wisdom is the result of experience. His long robes denote
his

his high character, and their colour his gravity. He is represented sitting, to shew his authority; and with a chain of gold round his neck, to which is suspended a human heart, to denote his integrity. In his right hand is a book, to shew he has regard to law, and that from literature he obtains his knowledge. He may, however, in this situation be standing, as the bed-pillar will not so well admit of a sitting attitude; and in this attitude he may have a mirror in his left hand, surrounded with serpents, to denote prudence and speculation, as necessary to good counsel.

On the other pillar, opposite to the figure which represents the democratic branch of our government, there may be the emblem of Law, to denote that the members of parliament, as the representatives of the people, ought to be acquainted with the rights and interests of their constituents; and also, that in their debates on these subjects, they ought to regard the laws of the constitution.

Law is represented by the figure of a respectable elderly lady, sitting on a tribunal chair. Her age denotes that law is an ancient subject; she is seated to denote eminence, and holds a sceptre in her right hand to denote authority. In her left hand she holds an imperial crown, allusive to the law of nations,

importing that no nation can exist without laws. Her head is adorned with diamonds, to signify that law is most precious, and that its origin was from God.

At the end of the bed, and next to law, Obedience or Subjection may be introduced, to denote the duty and respect which the people owe to their representatives whom they have appointed, and particularly to signify that subjects ought not to rebel against government.

Obedience is described by the figure of a humble woman, in an upright position, with her eyes towards heaven, to denote her regard to its commands as the Appointer of government. Her upright position not only shews her willingness to obey, but that government was never appointed to oppress or bow down the backs of those who are willing to obey just laws. She is dressed in white robes, denoting innocence; and across her shoulders is a yoke, the emblem of patience and obedience. By her side may be represented a dog, which is a symbol of obedience and faithfulness.

On the center of the cornice may be represented Authority, to denote that without its influence law is rejected and condemned,—obedience is without foundation, and therefore government could not exist.*

Authority is represented by the figure of a matron, or old lady, to shew that the institution of authority which gives effect to laws is ancient as law itself. She is seated on a regal chair, because princes and magistrates generally perform their office sitting, indicating tranquillity of mind. She holds a sceptre in her left hand, denoting regal power and authority; and by her side are arms, to signify her power to punish the licentious, and protect the obedient. In her right hand is a book, resting on her knee, to denote that civil authority is of divine origin*.

On the other pillar may be the representation of Tyranny chained down, with her back bowed, to signify that those in authority ought to suppress rather than cherish it; and to shew that tyranny ought, in all good governments, to be at the foot of power, to prevent its baneful effects in a state. The emblem of this noxious quality is a pale, proud, and cruel-looking woman, dressed in armour, and purple drapery, to denote her readiness to shed blood in the defence of her arbitrary measures. In her left hand is a yoke, and in her right an uplifted sword, to shew that she is ready to enslave mankind, and punish them if they will not put on the yoke. She wears an iron crown, to shew that the authority which tyrants seek is for base purposes and cruelty.

* See Rom. xiii. 1.

To make these three figures harmonize—Authority, at the top of the cornice, may be represented as looking towards Obedience with an eye of approbation; and the book lying on her lap, with the right hand she may hold a dart pointed directly to Tyranny below. And to represent Tyranny in the most wretched state, her iron crown may appear to tumble off her head, her yoke broken, and her sword pointed to her own breast, to shew that in the end tyranny is her own executioner. Thus, I think, the end of the bed will exhibit emblematically the end of civil government, which is to protect the innocent and obedient, to suppress cruelty and oppression, which are the life and soul of tyranny. The front side shews the nature of our government, the dome the principles which support it, and the back side the way in which government is managed.

The ornaments on the head-board are emblems of love and continency, expressed by the figure of Cupid, Chastity, and a trophy below. Cupid is represented as drawing his bow to guard Chastity from the violent attempts of Impurity, whose figure, partly a woman and partly a monkey, is behind the curtain, to denote that such as practise it lurk in secret.

The emblem of Chastity is the figure of a young woman in white robes, to denote purity and innocence. Her head is crowned with a garland of cinnamon, a pleasant and costly plant,

to signify that Chastity is a virtue both pleasant and valuable. She is veiled, to express her modesty; and in her right hand holds a scepter, as a sign of her conquest over lust. In her left she holds a turtle dove, which is an emblem of continence.

With respect to the manufacturing part of this bed, it should be observed, that the curtains draw up by a pulley at the several corners, detached from the drapery valence which is fixed to the cornice.

The tester on which the dome rests, is made perfectly straight, and forms an even surface on both sides; which, in the inside, is pannelled out with gilt moulding at each angle.

The quadrantal pannels recede back from the cornice, and are framed into the top of the pillars, which are left square. The ground of these pannels being continued the whole length, from pillar to pillar, serves as a fascia on which to fix the cornice. Then observe, that the basket of fruit and the lyre being in one piece, they are fixed to the pillar, and meet in a miter with the other side.

The oak foliage is in one entire piece, and screwed up to the bed-sides, after the drapery valence is tacked to a rabbet made for that purpose.

Every

Every other particular must naturally occur to the workman, after what has already been said on the other beds in this work. Upon the whole, though a bed of this kind is not likely to be executed according to this design, except under the munificence of a royal order, yet I am not without hopes that useful ideas may be gathered from it, and applied to beds of a more general kind.

Of the Dressing Commode. Plate XX.

WITH respect to the dressing part of this commode, it may be made either fixed fast, or to be brought forward in the manner of a drawer, with leapers to keep it to its place. If it is made to be fixed fast, the doors may be opened to form the knee hole.

The top which covers and encloses the dressing part, slides down behind, in the manner described in page 407, to which I refer the reader; only observe, that in this top there are miters to fit the straight moulding in front when the top is put down. A bottle of water, and a pot to receive it when dirty, can both be kept in the cupboard part.

The dressing-table below can require no explanation, except what relates to the size, which from front to back is
eighteen

eighteen inches, thirty-four the whole height, and two feet four the length of the front.

Of the Sideboard, with Vase Knife-cases. Plate XXI.

THE pedestal parts of this sideboard may be made separate, and then screwed to the sideboard. The top extends the whole length, in one entire piece, and is screwed down to the pedestals. The hollow plinths of the vases are worked in one length, and mitred round. The top of the plinth is then blocked on at the under side, and the vase part is made to screw into it, so that the vases may occasionally be taken off. A cross band is meant to be mitred all round the hollow plinths, coming forward to the edge of the top; so that if the top be veneered, it will only require the length between the two plinths. Within the front is a tambour cupboard, which is both useful, and has a good effect in its appearance; almost any workman will know how to manage this, so that I need not explain it. The ornament behind is brass, intended as a stay to silver plate, and has branches for three lights. The circle in the center may have a glass lustre hung within it, as an ornament. For any other particular relative to sideboards in general, see page 363, where the common principles of this useful piece of furniture are explained.

Of the Library Steps. Plate XXII.

THESE steps are considerably more simple than those already described; and though not so generally useful, will come vastly cheaper. The upper flight of steps turn down upon the under ones, both of which rise up and slide in as a drawer; after which a flap, which is shewn in the design, is turned up, and has the appearance of a drawer front. Observe, that the resting post at the top folds down to the side of the steps by means of an iron joint. The horse has green cloth under its feet, to prevent its scratching the top. The design shews that the two steps are connected together by hinges, so made as to clear the edge of the table-top; and also, that there is a sliding board to which the under flight is hinged, which sliding-board runs in a groove.

The length of the table is three feet six inches, its width twenty-two inches. The table is thirty inches high, the upper flight is thirty perpendicular, and the resting-post thirty-three. This, and the other design for library steps, have obtained a patent; yet any part being materially altered, will evade the act, though the whole be nearly the same. Those masters, however, who do not think it worth their while to be at the trouble

of introducing any essential alteration in them may have these steps from Mr. Robert Campbell and Son, Mary-le-bone Street, London, with a sufficient allowance for felling them again.

Of the Chamber Horse.

THE upper figure shews the inside when the leather is off, which consists of five wainscoat inch boards, clamped at the ends; to which are fixed strong wire twisted round a block in regular gradation, so that when the wire is compressed by the weight of those who exercise, each turn of it may clear itself and fall within each other.

The top board is stuffed with hair as a chair seat, and the leather is fixed to each board with brass nails, tacked all round. The leather at each end is cut in slits to give vent to the air, which would otherwise resist the motion downwards.

The workman should also observe, that a wooden or iron pin is fixed at each end of the middle board, for the purpose of guiding the whole seat as it plays up and down. This pin runs between the two upright pieces which are framed into the arms at each end, as the design shews.

The.

The length of the horse is twenty-nine inches, the width twenty, its height thirty-two. To the top of the foot board is eight inches, and to the board whereon the seat is fixed is thirteen.

Of the Corner Night Tables. Plate XXIII.

THAT on the right requires no explanation, except that the doors may be hinged to turn in, if it is thought most convenient.

The table on the left is intended to answer the purpose of a wash-hand stand occasionally. To answer this end the top part is framed together of itself, and fixed by an iron or strong wooden pin, into the back corner of the lower part, which contains a socket, so that the top part can be turned to one side, as shewn in the design, or as much further as is necessary to clear the hole.

Observe also, that on the front is worked a groove, in which a pin passes that is fixed to the front of the bottom of the upper part, and prevents the top part from turning quite off from the bottom, which would endanger the pin on which the top part turns; it should have castors at the brackets, that when the
night

night table is wanted, it may be drawn a little forward from the corner of the room to give place for turning round the upper part. It should be about thirty-four inches to the top of the basin shelf. The height of the seat sixteen inches and a half, and its other dimensions are known from the plan. The bottom drawer may be made neat, and drawn out by means of a dovetail groove in the middle of the drawer, ~~and a~~ piece to fit it fixed across the bottom of the carcase.

Of the Pulpit. Plate XXIV.

THE design of introducing a pulpit into this work was to afford some assistance to the cabinet-maker, who in the country is generally employed on such occasions. In erecting a pulpit of this kind, three particulars ought principally to be regarded. First, the plan; secondly, the manner of conducting the steps and hand-rail round the column; and, lastly, to fix the whole firm, so that it may not by shaking produce a disagreeable sensation to the preacher.

The plan of this pulpit is a regular hexagon, which to me is the most beautiful and compact of any. One of its sides is occupied by the door, and one for the back of the preacher, another to rest his arm, and the remaining three for the cushion.

The plan of the steps is a circle, which is most convenient where there is a want of room. The plan should be divided according to the number of steps necessary for attaining to a proper height, which in this case is twelve, as one, two, three, &c. in the plan.

A section should then be drawn, and the height of the risers adjusted to the number of the steps, as in the section *a, b, c, &c.*

Draw the semi plan P, and divide the circumference into eight equal parts, as 1, 2, 3, 4, &c. because, that in the plan there are so many steps contained in its semi. Draw from 1, 2, 3, 4, &c. lines perpendicular, and continue them to the uppermost step. From *a*, the first step, draw a line to *a* on the plan P. Do the same from *b* to *b*, *c* to *c*, and so of all the others, which will describe the steps and risers as they revolve on a cylinder. The face mould for the hand-rail, when it is cut out of the solid, is found as follows. See Plate XXX. Draw a quarter plan as there described, divide the chord line into any number of equal parts, as 1, 3, 5; from which raise perpendiculars to intersect the circumference; draw next the rake or pitch-board of the steps at Fig. R, by taking the breadth of the step on the plan, and repeating it 1, 2, 3, 4; then take the

the height of four risers, as from x to y , and draw the line $y4$, which line will be the chord for the face mould; therefore take $y4$, and divide it into six, as in the plan of the hand-rail. Take the perpendicular heights as 1 2, 3 4, and 5 6, of the plan, and transfer them to the correspondent perpendiculars on the face mould; which will give points through which the curve is to pass, to form the face mould, as the figure shews. Three of these lengths will be wanted to complete the hand-rail, including the ramp and knee.

These hand-rails are however sometimes glued up in thin pieces round a cylinder in one entire length, after which a cross banding is put on the top, and rounded off. In this case a cylinder is formed in deal, and the line of the steps is traced out as described Plate XXIV. which is the guide for the thin mahogany to be bent round. In fixing the steps, I presume it will be found the best method to mortice and dovetail the risers of each step into the pillar: this may be done by making the mortice as much wider than the breadth of the riser as the ~~dovetail~~ is intended to be in depth, so that when the riser is put into the mortice, it may be forced up to its place by a wedge driven in at the under edge of the riser. By this means it will be impossible that the steps should work when they are tongued and blocked together. The soffits of the steps are in the form of an
ogee,

ogee, answerable to the brackets, and are fitted up separately afterwards.

In fixing the pillar it must be noticed, that it is first tenoned into transverse pieces of oak timber, which are sunk a good depth into the ground, so that when the clay is beat in solidly about the pillar it cannot work ; yet it is easy to conceive, that in the pulpit it will be liable to spring when the preacher is in it; to prevent which I have introduced a light small column, situated in the center of the pulpit, and connected with it by a cove, on which the pulpit rests. The sound board is made as light as possible, which finishes in an octave cove at the top, and is fixed to the pillar by a strong screw and nut, together with a tenon, which is sunk into the sound board. The bannisters of the hand-rail may be straight bars of brass, made very light, dovetailed into the ends of the steps, and let into a plate of thin iron at top, which is screwed to the under side of the hand-rail.

Observe, that on the left side of the plate is a scale of feet and inches, from which the various measurements may be taken.

N. B. Plates 25 and 27, 28 and 29, require no explanations ; they are therefore omitted.

Of the Ladies' Work Tables. Plate XXVI.

THE table on the left is intended to afford conveniences for writing, by having a part of the top hinged in front to rise up. This rising top when it is let down locks into the frame, and secures the bag where the work is. The standards on which the table frame rests have transverse pieces tenoned on, which screw to the under side of the frame. The drapery which hides the work-bag is tacked to a rabbet at the under edge of the frame all round.

The design on the right is simply a work table; the upper frame, to which the top is hinged, is about two inches broad, made separate. The pillar is fixed to the bottom of the bag, which is a round frame made of wainscot, with a stretcher across each way, for the purpose of fixing the pillar to it, and to strengthen the frame. The upper frame, already mentioned, is connected with the lower one by small upright pieces tenoned in, after which the bag is formed of silk, and tacked to each frame, and ornamented on the outside with drapery.

Of the Drawing Table. Plate XXX.

THIS table will be found highly useful to such as draw, it being designed from my own experience of what is necessary

for those who practise this art. The top of this table is made to rise by a double horse, that the designer may stand if he please, or he may sit, and have the top raised to any direction. As it is sometimes necessary to copy from models or flower-pots, &c. a small flap is made to draw out of the top, which may be raised by a little horse to suit any direction that the top may be in, so that the model or flower-pot may stand level. The sliders at each end are necessary for the instruments of drawing, and for a light to stand on. The long drawer holds paper, square and broad, and those drawers which form the knee hole are fitted up for colours.

Of the Drawing Room. Plate XXXI. and XXXII.

WITH respect to the section, it is only necessary to observe, that the pier table under the glass is richly ornamented in gold. The top is marble, and also the shelf at each end; the back of it is composed of three pannels of glass, the Chinese figure sitting on a cushion is metal and painted. The candle branches are gilt metal, the pannels painted in the style of the Chinese; the whole producing a brilliant effect.

The view, Plate XXXII. contains an otomon, or long seat, extending the whole width of the room, and returning at each

end about five feet. The Chinese columns are on the front of this seat, and mark out its boundaries. The upholstery work is very richly executed in figured satin, with extremely rich borders, all worked to suit the style of the room. Within this otomon are two grand tripod candle-stands, with heating urns at the top, that the seat may be kept in a proper temperature in cold weather. On the front of the otomon before the columns are two censers containing perfumes, by which an agreeable smell may be diffused to every part of the room, preventing that of a contrary nature, which is the consequence of lighting a number of candles.

The chimney-piece is rich, adorned with a valuable time-piece, and two lights supported by two Chinese figures; on each side of the fire-place is also a Chinese figure, answerable to those which support a table on the opposite side, under which is seated a Chinese figure. Over each table, the fire-place, and in the center of the otomon, is a glass, which by their reflections greatly enliven the whole. The subjects painted on the panels of each wall are Chinese views, and little scenes. The carpet is ~~work~~ in one entire piece, with a border round it, and the whole in effect, though it may appear extravagant to a vulgar eye, is but suitable to the dignity of the proprietor.

N. B. In addition to what has been said on perspective in the first work, I would here annex a few remarks on taking the geometrical or original measurements of a piece of furniture drawn in perspective, supposed to be destitute of any lines or scales.

In Plate XXX. is therefore inserted a view of a bookcase, figure K, which the reader must imagine to be without any lines except those which form the outline of the piece. It must, however, be premised, that a workman is acquainted with the proportion of some one or other of its parts, without which nothing can be done or ascertained. He must also be acquainted with so much of perspective as to know that a line passing through the diagonal of any square, if produced, cuts the horizontal line in the point of distance. These being known, proceed first to find the horizontal or vanishing line by producing *c d*, the top of, and *f r*, the bottom of the under part, till they meet in a point, as at *s*, which will be the point of sight; through *s* draw a line parallel to the front of the bookcase, which will be the horizontal line sought for. From the point of sight draw at random lines forward from *p*, and *e*, or any other point that may be necessary. Next find out the point of distance, without which the depth of the ends cannot be known: in order to this, the workman must recollect that the brackets are
always

always as long at the ends as on the front, and that therefore they form a square block; wherefore take $4f$, and place it from f to g , and from g to h , the end bracket will be the diagonal of a square, whose side is $4f$; produce the line $g h$, which will cut the horizon at D ; the distance, as the line on the leg of the gouty stool, passes to the distance which is out of the plate. Lastly; from D draw lines forward through r and 10 , or any other part, till they cut the front line, as at $t w$, by which will be discovered the proportion that the ends bear with the front, and how much the lower part projects before the bookcase. Now if there be a scale of the front already to the design, then the whole can be determined; for by taking the compasses extended to a foot, and repeating it on the perpendicular line from a to h the height of the doors are known, and by the same rule the height of the pediment from l to m . Then if the same compass be applied from f to w , the depth of the lower part, it will be found vastly out of proportion with the front, which I have done on purpose, to shew that by a comparison of this sort the errors of a design in point of perspective may be discovered. If, however, there be no scale to the design, then it will be necessary to assign a certain portion for a foot, as near as we can judge, by considering the common length of a bracket, from f to 4 , which in general is about four and a half or four inches, which repeated three times, finds a foot, as in this case, and then

it appears that the front is four feet long, and better than four feet high, that the doors are five feet nine high, and so of the rest. But if there be no bracket, any other part may be taken whose measure is known, as the partition of a drawer, which is generally seven eighths thick, the height of a slider, about thirty-two inches, or the depth of a secretary drawer, about ten inches. ~~The usefulness~~ of this method is not confined to pieces of furniture, but may be applied to any kind of regular perspective.

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AN ACCOMPANIMENT, &c.

Instructions for Drawing Ornaments.

As a proficiency in the art of drawing ornaments depends chiefly on the habit of copying and the natural turn of genius in this way, a few hints only are necessary for the assistance of the learner.

Some instructions, however, are certainly necessary, as appears from the frequent applications that are made to masters for their information. And though no written instructions can fully supply all that may be derived from a master*, yet such directions may be given, in letter-press, as greatly to facilitate the attainment of this useful branch of drawing without a master's help.

The principal art of every branch of drawing is included in the disposition of a few simple lines of but two different species,

* One very material advantage derived from a master is, that the pupil sees how he practises, by which he may acquire his manner and style.

the right line and the curve. Of these two are composed all that infinite variety of shapes that we are able to see and conceive.

I will, therefore, propose to the learner, first to begin with drawing, by the hand, right lines a tolerable length parallel to ~~each other in~~ all directions; first, inclined to the right, as approaching nearest to the art of writing; secondly, perpendicular; thirdly, inclined to the left; and lastly, horizontal and at right angles with those perpendiculars, and passing through their center. A proficiency in this is certainly the first step in drawing, and is not so easily attained as may be imagined.

Secondly, let the learner then proceed to draw by the hand a circle, as large as possibly he can without moving the wrist. And it will be proper for the learner to observe, that in being able to draw a circle by the hand and eye he thereby draws curve lines in all possible positions, as perpendicular, inclined to the right and left, and horizontal. In addition to this practice it will be necessary to draw one circle concentric with another; that is, as when two or more circles of different diameters are drawn from one center. This becomes useful when any thing is to be described in the shape of volutes, as the running foliage frequently introduced in friezes and pilasters. What has here been said of the circle will also apply to the practice of drawing an
 ellipsis

ellipsis by hand. An ellipsis may be considered as a curve consisting of a number of segments of circles compound, whose radii differ in length. Of this kind of curve are many of the turns in ornament, and therefore the practice of drawing them will be found worthy the attention of the learner. To practise as has been described I consider as indispensably requisite to a ready and perfect attainment in the art of drawing ornaments; and ought particularly to be recommended to youth, as a help to their writing any kind of hand, or drawing the Roman letters.

The learner who is advanced in years will not, perhaps, submit to this kind of teaching: but if he cannot already draw right lines, of some length, parallel in all positions, and a circle tolerably near by the eye, he ought not to be above learning it, because the time that is spent in this, will be deducted in future by a more speedy progress in the art of drawing ornaments. And however this may be thought of by some as a thing of no merit, yet we will venture to affirm, that the hand of a real master may be certainly distinguished by the manner of drawing these.

Of Copying Ornaments. Plate I.

SUPPOSE C to be the example to copy from. Take a black-lead pencil, and draw at B the principal curve-line at the bottom very faint*. Then proceed to form a rude sketch of the outline, observing carefully each projecting part of C, that a sufficient breadth or space may be taken within the out-line, in which may be formed all the distinct parts of B, without reducing their proportion.

Upon this process correctness and dispatch very much depend. Therefore, if upon the first attempt of this there should appear any defect, it will be best to take out the lines with the India rubber, and make them perfect.

A carver or sculptor proceeds upon this principle until merely the massive parts are made out; and it is well known that those of the greatest skill in these professions are always employed in this part of carving and sculpture.

After having done this, proceed to give the distinct forms of each leaf and rose in faint touches, that if there should be any cause for alteration it may be more easily effected. The

* To handle a pencil is, in many cases of drawing, different from the manner of holding a pen. In handling a pen, the ends of the fourth and fifth fingers rest on the paper; but in managing a pencil, the hand is turned over more to the right, and rests on the knuckles of the little finger.

learner should, in doing this, carefully observe and touch the fibres of each leaf, and give the proper lead to each stem, so that they do not cut each other.

Lastly, take a view of the whole, and consider in what point the light is to strike on the ornament; and on that edge of the leaves and roses opposite to it, retouch and strengthen the outline in such a way as to give relief and effect to the whole, even upon supposition that the drawing is to remain a mere outline.

Of Shading Ornaments.

If the ornament is to be shaded with Indian ink, mix some of it thin and clear, and take a crow-quill pen, or fine camel-hair pencil, and touch the outlines very faintly, so as scarcely to be seen on the light edges of the ornament; because in nature there is, in reality, no outline on the light sides of objects, especially if the sun is supposed to shine on them. After this, touch the stronger parts of each stem and fibre, that they may not be lost when the pencil marks are expunged.

Having cleaned your drawing, take a large camel-hair pencil, and dip it till it flow freely with Indian ink very thin and clear. And observe, that if the ink do not work with freedom on a piece of waste paper, which should be kept for the purpose

pose of trying the pencils, the brush in this state ought not to be applied, but should again be well worked in the thin Indian ink, so that it work easy, without leaving white spots on the paper. In this state apply the pencil to the ornament, and give a general tint to those parts supposed to be all in shadow; at the same time a partial tint may be given to the objects, partly in the light. This first course of shadowing is the great basis of all real effect; for if the masses of light and shadow are not properly parted, but confounded, the drawing will look heavy, intelligible, and boyish.

When the drawing is properly dry, the last tints are to be given with great delicacy and care, lest the whole be over done, and, as it were, tormented with harsh dabs. The intention of this last tint is only to give reflected lights to those parts which lie in the mass of shadow, and sharpness to the partial shadows directly opposed to the light.

It is natural for the learner, in giving the last tint, to think of thickening his ink; but this must be avoided, as dangerous to the effect of ornament; for if the ink at first used be again repeated on the former tint, it will give sufficient colour, except the openings of the fibres, which may be touched with stronger ink.

Effect to ornament may also be given by a pen, in imitation of etching; which, if well executed, is more pleasing in ornament than Indian ink.

Italian chalk is sometimes used along with a black-lead pencil, which may be done with extremely good effect.

The learner, being furnished with these instructions, may proceed in the same way with the rest of the specimens in foliage, the principal variety of which is here exhibited.

K, is the thistle leaf, sharply pointed and irregular.

G, is the Roman-leaf, round and maffy.

F, the parsley leaf, light and rather sharp pointed.

E, the rose leaf, formed into groups.

D, The oak-leaf, broad and maffy, scolloped on the edge, with small partings.

A, Is a fancy leaf, rather sharp, with large partings.

C, roses and leaves alternately.

With these specimens the learner ought to be well acquainted, before he proceed to draw running ornaments, that he may give sufficient variety in each turn.

The regular leaves, in Plate XI, should also be copied, as they are much in use in carving and japanning.

Next proceed with the borders in Plate III, which are intended for japanning or inlaying; and so on with any other of the Plates, as Plate V. VII. and IV. as they may appear most suitable to his abilities in drawing; observing in all cases to make a very light pencil-sketch of the whole design, before any thing is attempted to be finished.

Of Qualifications necessary for Composition.

To qualify the learner for composition, he ought, in some measure, to be acquainted with the proportions of human figures, especially those taken from the antiques. My very limited plan in publishing these ornaments affords me no opportunity of doing any thing in this way by example. I will, however, give a few hints respecting their proportions, for the assistance of those who have no opportunity of consulting the best masters.

The

The proportion of the male figure, according to Mr. Brisbane's Anatomy, from Albinus, will be near enough, as follows: If the perpendicular height of the intended figure be divided into ten equal parts, and ~~one~~ of these parts into four, the proportions will run thus with respect to length: the head, from the crown to the chin, one tenth and one fourth; the neck rather more than one third of the head; from the summit of the shoulders to the bottom of the belly, three tenths; from the bottom of the belly to the center of the knee-joints, two tenths and one half; and ~~the same~~ from the center of the knee-joints to the bottom of the feet. Observe, the height of the hips are six tenths and one third from the ground, and the length of the arm four tenths and rather more than one half.

In thickness as follows.—Over the shoulders, two tenths and one fourth; over the hips, one tenth and rather more than three fourths; over the thick part of the thigh, one tenth; the small part, near two thirds. These principal parts being attended to, the rest will follow of course, by practising a little upon the different parts of the body from examples. When the proportion of any male figure is to be proved, take the thickness of the thigh as one tenth of its height, and by remembering the above proportions any figure may be examined. By these proportions I have examined a figure engraved from the famous Raphael, an Italian painter, and found them to agree exactly.

exactly. In respect to the female figure there is some difference in the proportions; the whole is more slender and elegant; the shoulders are not so broad; the trunk or body is shorter; the hips broader, and in proportion higher from the ground; and the muscular parts are not so strong and prominent. As female figures are frequently interspersed in the composing of ornaments, it is proper to observe, that much depends on the management of the drapery with which they are clothed. It ought to hang with freedom and ease, and in some parts to lie close, so as to discover some of the principal shapes. To effect this, it is best, first, to draw the figure by the pencil as if entirely destitute of drapery, and afterwards to lay the drapery gently over with Indian ink, or colour, as may be required; so that the lines which marked out the parts of the body, now covered, may be expunged. This method gives true effect to the drapery, by enabling us to determine where there ought to be strong, where slight, and where no folds at all. On the prominent parts of the body there are no folds in the drapery; but after having just passed over these, the folds commence in tender marks, and increase into strong folds where the drapery is detached from the body.

In examining Cipriani's figures, I find, that if the assigned height of the female figure be divided into ten equal parts, from the ground to the waist, where the drapery is sometimes tied
round,

round, is seven tenths ; from the waist to the top of the shoulders, one tenth and an half ; the neck a quarter, the head one tenth and a quarter, and over the shoulders rather more than two tenths.

As boys or cupids are frequently introduced in ornaments, it is proper that the learner should take notice of their proportions and general appearance, as different from those already described. Cipriani's boys are of the following proportions :— If the assigned height be, as before, divided into ten equal parts, the head will be full two tenths in height ; the neck very short ; from the top of the shoulders to the bottom of the belly, four tenths ; from the bottom of the belly to the knee-joint, full two tenths ; and from the knee to the ground, bare two tenths ; the arms, when hanging perpendicular, come not quite to the middle of the thigh ; the breadth of the shoulders not quite three tenths ; and, lastly, the thick part of the thigh, one tenth and an half, which will of course give the proportion of the leg. The learner should observe the general cast of these figures ; the head is large and round ; the neck scarcely distinguishable between the head and shoulders ; no joints appearing in the arms or legs scarcely ; the ankle covered with flesh, and the whole leg thick and maffy.

But, beside the human figures, there are others of an imaginary

ginary kind employed by the antiques in their decorations. These are still, and ever will be retained in ornaments less or more. The most tasty of these were selected by Raphael, and painted by his pupils on the walls and ceilings of the Vatican Library at Rome, and which are handed down to us, by the Italians, in masterly engravings; which, in the course of this work, I have consulted, and from which I have extracted some of my ideas, as well as from some French works.

In the Vatican are figures whose upper part is female, and the lower of foliage entwisting round. Other female figures have their lower part of a fish, and some of a greyhound. Others shew only a human head, with foliage springing from it in different forms, answering for wings, and for a covering of the lower parts. In it, we see sometimes a dolphin fish with an ornamented tail; a lion's head and an eagle's leg and talons brought into a smooth outline by the help of foliage: at other times a tiger's head and paw formed in the same manner. Some, again, are partly a horse with wings and two fore legs, and partly the tail of a fish; all which are now a nameless generation, but once the offspring, I presume, of the ancient metamorphoses, either what they termed real or apparent.

Besides these, are to be seen, in the above work, the sphinx, a figure of much fame amongst the ancients, whose upper part

is

is a woman's head and breasts, and the wings of a bird; the lower part the body of a dog, and the claws of a lion. This monster is said to be the production of two deities, and sent as a scourge to the Thebans. Its business, on a mountain at Thebes, was to propose dark questions to passengers, and if not answered to devour them. It is said that the Egyptians used the sphinx as a symbol of religion, on account of the mysteries, which it was capable of interpreting. The Romans therefore placed it on the porches of their temples.

The centaur, partly a man, and partly a horse, used as one of the signs of the zodiac, in which the man part is represented shooting with a bow.

This being is also said to be the offspring of a deity in conjunction with a cloud. They inhabited Theffaly; and, engaging in hostilities with the bow, were vanquished by Theseus. As they seem to have been a rebellious race, they may be introduced into such subjects as are intended to shew the odium of such conduct.

The griffon is another fabulous being, existing only in the vain imaginations of the ancient heathen poets, as do the two former. They represent it partly an eagle, and partly a lion; that is, the lower part of it. They suppose it to watch over golden

golden mines and hid treasures. It was consecrated to the sun, whose chariot was drawn by a number of them. And these, if you please, may be introduced into subjects intended to represent covetousness; or they may be placed over cabinets where treasure is kept.

It will be proper that the learner should study to compose these, if he intends being a proficient in ornaments. In short, to be fully qualified for ornamental decorations, is to be acquainted with every branch of drawing.

And, further, to compose to much purpose, it requires to have a general insight into works of this nature, and particularly to see the painted walls in noblemen's houses, in many of which the art is exhibited to its utmost perfection; and in none more so than in the printed and painted silks executed of late by Mr. Eckhardt, at his manufactory at Chelsea, adapted for the purpose of ornamenting pannels, and the walls of the most elegant and noble houses.

Of Composition.

AFTER the ideas of the pupil are extensively furnished in the manner now described, it will be proper to begin with some small ground to compose on, such as the frieze of a cornice;
and

and to consider its situation with the eye, whether it be intended to be much above it, so that the parts of the ornaments may suit the supposed distance of the eye from it. It is of no effect to put a number of small ornaments in, to be viewed at a great distance. In this case the parts should be simple, entire, and rather massy, to produce a proper effect. If the frieze be near the eye, it may then be divided into smaller parts; but to crowd it in any case ought studiously to be avoided. And observe, the tablets of friezes ought to be diverse to the other ornaments in it.

I would then recommend to compose on the ground-work of a pilaster not very broad; for it is to be observed, that the difficulty increases in proportion to the width, more than in the height of a ground-work. The ornaments in a pilaster or panel is considered as growing upwards, and therefore it ought to take its rise from something principal at the base, and grow rather lighter towards the top, as in every instance is shewn in nature. But this does not confine the composer to suppose that every thing is to be fastened or tied to each other as in strict nature, for this would sometimes be the source of heaviness in ornaments; nor do I see it practised in the Vatican, or by any of the best artists in this way. But certain it is, that the best compositions are those which keep the parts most connected in one entire piece. The more we attain to this, whilst we avoid a

heavy repetition of the same parts, the nearer do we arrive at perfection in this art.

The ornaments of a pilaster ought to fill regularly on each side, and not to leave much naked ground. And especially we ought to observe, not to have the ground alternately crowded and naked. If we begin in an open style, leaving much naked ground, this should be continued uniformly all the way up, and, if any thing, only to grow more open at the summit. The laws of harmony in every art, where time, motion, and space are observed, require this.

If the surface to be ornamented be horizontal, and is liable to be viewed alike in all points, as in a ceiling, the subject should be regular, and formed into pannels and groups, surrounded with foliage of the same kind and form on all sides. Nature exemplifies a regularity in most flowers, and in other things that grow horizontal.

Lastly, to compose ornaments for a large upright pannel, as in rooms, is by far the most difficult task in this art. Here it is required that the artist collect and arrange all his ideas; and those scattered fragments which exist in his mind through long and repeated observation on the works of the best masters, must now be collected to form an entire whole, by a general concurrence

or assemblage of every branch of drawing. In this large field, architecture, perspective, figures, landscape, foliage, and fruit, may vie with each other, and shew the master's skill.

Attempts of this nature may be made by the learner, and with success, though he fall vastly short of a perfect display of all these different branches of drawing; for it is to be observed, that the rule for judging in works of this nature is not to look for eminence in each and every distinct branch, but to discern fine taste and justness of composition in the whole.

In compositions of this nature something spreading and massy ought to be at the bottom of the pannel, except the ornament be only intended to occupy the center, in which case the principal part of the ornament should be in the middle; but where the entire pannel is to be filled up, we should begin as above, that there may be an opportunity of giving breadth to the foliage, for the purpose of filling up the ground regularly from one beginning only, for two designs must not be entwined with each other in the manner of cyphers. This destroys the beauty of simplicity, which consists in fewness of parts, and entanglement of forms, without which all is a jumble.

This observation will teach us to avoid that kind of crossing and cutting each other, something like the rigging of a ship,

which may be observed in some ornaments, even of French production as well as English. A practice this, which always denotes bad composition, and a barrenness of thought. It is done with a design to enrich, but it only turns out to be a filling up to the prejudice of the whole. The learner must therefore study to enrich by a variety of thought springing from something, yet without interfering with each other.

He should also be careful in avoiding the appearance of straight lines continued from bottom to top, which is formal and bad. Some continuance of a right line is beautiful; but it ought quickly to be broken in these compositions, whether perpendicular or horizontal.

Observe breadth in the parts, shun niggling and meanness, and stick at nothing that will have a comely and pleasant appearance.

An Explanation of the Plates.

“ PLATE II. are chair legs. That on the left is intended for japanning, and is formed square. The other two on the right are turned, carved, and gilt.

Observe,

Observe, the plinth of the center foot is left square, and pannelled out.

If the leg on the right be thought to have too much work, the husks in the flutes and the drapery on the plinth may be omitted.

Plate III. Borders for japanning or inlaying.

Plate IV. Ornament for a pannel. The whole springs from a spreading leaf at the bottom, from which a serpent attempts to come at the doves on the fruit. In the center is a temple not dedicated to the interests of the cupids, for which reason they are burning it with their torches. The figure on the top of the column, in resentment, means to pelt them with stones; and the geniuses above are pouring down water to quench the flames. The owls are emblematic of the night, at which season these mischiefs are generally carried on. The other designs in this plate require no remark.

Plate V. Ornament for a tablet, intended for painting on a grey or blue ground, as best calculated to throw forward the figure and fruit.

In the cornices, the acorns in one, and husk in the other, are

are turned with a pin; by which they are fixed into the large projecting square.

I would advise to work the upper part of the cornice separate, by which means the acorns will be more easily fixed. The frieze may be carved, painted, or inlaid.

Plate VI. Designs for Bed-pillars.

No. 1 and 2 are to be painted; No. 3 carved in mahogany; and No. 4 and 5 are intended for rich state-beds, carved in white and gold. The scale of feet and inches at the bottom will give the heights, and other proportions.

The pateras which cover the screw heads are on loose panels let into the pillars, and which settle down into a groove at the bottom, by which means they are kept in their place, and easily taken out.

Plate VII. Ornaments for the center of a pembroke and pier table needs no explanation.

Plate VIII. Of chair splads.

No. 1, 2, 3, and 6, are intended for parlour chairs, carved in mahogany.

No.

No. 3 and 4 are for painted chairs. Observe, the curve lines which come from the top rail at No. 2 and 6 are intended to shew where the outside splads in a complete back will come in, answerable to No. 4.

Plate IX. Of toes and knees for pier and card tables.

No. 1, 3, 5, are meant for pier tables, the ornaments of which are intended to be carved and gilt.

No. 2, 4, 6, are for card tables, with stringing and pannels let in.

Plate X. Of chair elbows, with part of the seat, together, with splads for chair backs.

The splads are all intended for japanning, except No. 4, which may be worked in mahogany.

The elbows are meant chiefly to be carved and gilt; but the mere outlines of any of them will serve as patterns either for painted or mahogany chairs, by leaving out the ornaments for the mahogany, and retaining some of them, or even all of them may be adapted for painting.

It may be proper to observe, that as high as the stuffing of the seat a rabbet should be left on the stump to stuff against; which is easily done, as the stump is made smaller above the rail. The cushions on the arms are formed by cutting a rabbet in the arm, or leaving the wood a little above the surface. Some, however, bring the rabbet square down at each end, covering the wood entirely, except a fillet, which is left at the bottom and continues round the cushion.

Plate XI. Ornament for a tablet intended for a painting, but which might be enlarged very well.

The subject is a faint moonlight scene, representing Diana in a visit to Endymion; who, as the story goes, having offended Juno, was condemned by Jupiter to a thirty years sleep. It may not be improper to advertise some, that these, with a thousand other of the same kind of stories, are merely the fabrications of ancient poets and idolaters, forming to themselves innumerable gods, according to their vain imaginations, and which now, only serve to try the painter's skill in decorating our walls. And in opposition to these vanities, I cannot well omit whispering into the ear of the reader, that "To us there is but one God, the Father, of whom are all things." I Cor. viii. 6.

Plate XII. Cornices for Windows.

The one across the plate is intended for japanning, the upper one for carving and gilding, and the two under ones may be either carved or japanned.

The circular ends of this cornice are sometimes formed of a faintish curve, and sometimes of a quick one. When they are of a faint sweep, they ought to be made somewhat longer at each end than the outside of the architraves, to give place to the curtain rods, so that they may be brought sufficiently forward on the lath, and not leave too great a vacancy between the rod and cornice leaves, otherwise the lath will be seen when there is no drapery. In making these cornices, it is best to plough and tongue in the leaves to the under side of the fascia of the cornice. The ends may be formed by gluing blocks of deal one on another till they come nearly to the sweep; and after having formed the outside curve, I would then advise to gage on for the plough-groove for the leaves, before the wood in the inside is brought to its form, that the pieces for the leaves may be put in without splitting off the groove. After these are well dried, then the superfluous wood on the inside can be taken away.

When the cornices are made at each end with a quick curve, the whole is first worked in straight mouldings, and mitred together at each end, the same as if intended to be square, according to the old fashion. When they ~~are~~ glued in the miters, get out blocks of deal, about two inches and an half square, and cut them down anglewise, and let their length be equal to the width of the cornice and length of the leaves.

After these blockings are dry, cut off as much of the old miter as is sufficient to form the curve, and work the mouldings again by hand; and observe, that as the block was left long enough, the curved leaf is intended to rest against it, by which it will be much strengthened.

The cornices made thus, with a quick curve, needs not be ~~made longer~~ longer than usual, because the quick curve admits the rod to come forward more easily than the other.

Plate XIII. Pilasters for Commodes.

These may be painted, inlaid, or gilt in gold behind glass, and the glass being then bedded in the pilaster, it is secure, and has a good effect.

Plate XIV. Chair Legs.

The center leg is worked square; that on the right is octagon, except the vase at the knee; and that on the left, round. These may, in the view of some, be thought too full of work; but the skilful workman will easily see how to reduce their richness, and accommodate them to his purpose.

F I N I S.

